

02406

# DETRICK ARCHES

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# DETRICK ARCHES

*Showing their adaptability to  
all types of boilers and stokers,  
special furnaces and oil stills*



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## The Functions of an Arch

**A**N arch is the roof of a furnace. When placed under boilers, it also directs the flow of hot gases, hastens ignition of the fuel and facilitates complete combustion.

There are two distinct types of arches—the sprung arch, which is built in the shape of an arc between the two side walls of the furnace, and the flat arch, which consists of tile suspended from beams which rest on the side walls.

With a sprung arch there is an outward thrust on the side walls of the boiler due to the pressure exerted by the arch. This thrust is taken up by horizontal beams placed in the side walls, which are called skew-backs. The skew-backs are held in place by vertical beams, called buck-stays, on the outside of the walls. These are held together by tie-rods. When repairs to a sprung arch are necessary, the arch must be entirely rebuilt. Because of the circular shape of this type of arch, the gases are collected at the center and are not directed uniformly toward the boiler.

Before combustion was considered a branch of engineering in itself, arches of various shapes and designs were installed at random, but as this important engineering subject was given closer attention, it was soon discovered that for certain types of furnaces and boilers considerable thought had to be given to the proper design and arrangement of the arch in order to obtain proper ignition and combustion of the fuel. In the burning of fuel in connection with nearly every type of boiler and stoker, the proper design and arrangement of the arch are of the most importance in furnace design. In fact, furnace design means, primarily, the proper design and setting of the arch.

The flat arch can be designed and placed in accordance with requirements of proper combustion. It can be set at any angle, or a combination of arches can be arranged to meet any furnace conditions. The flat under-surface of this type of arch insures even distribution of gases throughout the furnace. No buck-stays, skew-backs or tie-rods are necessary with this type of arch.





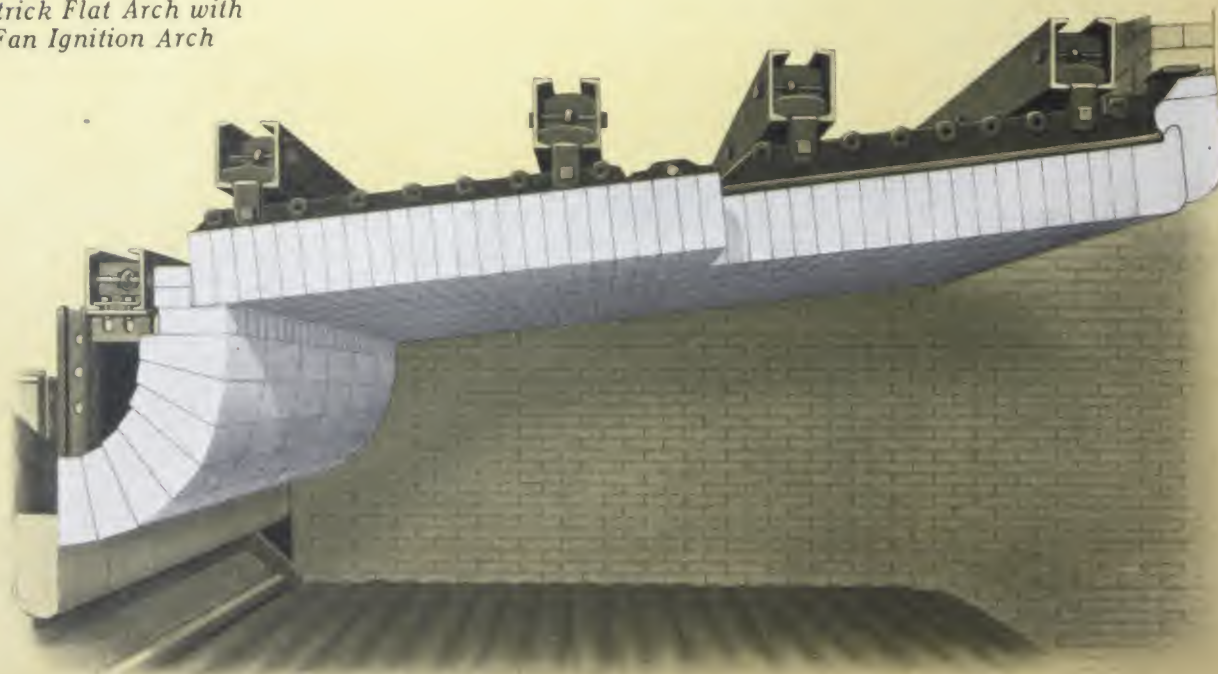
## The Detrick Arch

THE Detrick Arch is a flat arch. It consists of center-grooved tile hung from cast-iron hangers. Each tile hangs like a pendulum. These hangers are suspended from structural steel beams, which span the furnace and rest on the side walls.

With this construction, the arch-bars are hung from the steel cross beams and the tile are hung from the arch-bars. These two points of flexibility make it possible to swing the entire mass of tile  $1\frac{1}{2}$  to 2 inches laterally before the tile are grouted in place. Expansion and contraction are provided for by allowing a space at each side, which is packed with loose, dry asbestos. This is shown in the lower illustration on the opposite page. Details of construction of the rear end of the arch are also shown. The end tile is hooked on to the adjacent tile, and is not carried on the arch bar. Because of this construction, the end tile can be made small. The end of the arch-bar is well protected from the heat.

The apron wall is supported by a shelf casting, independently of the end tile. Any end tile can be removed without taking down the apron wall. One shelf casting is keyed to the end of each arch-bar, so that any one casting can be removed without disturbing the apron wall.

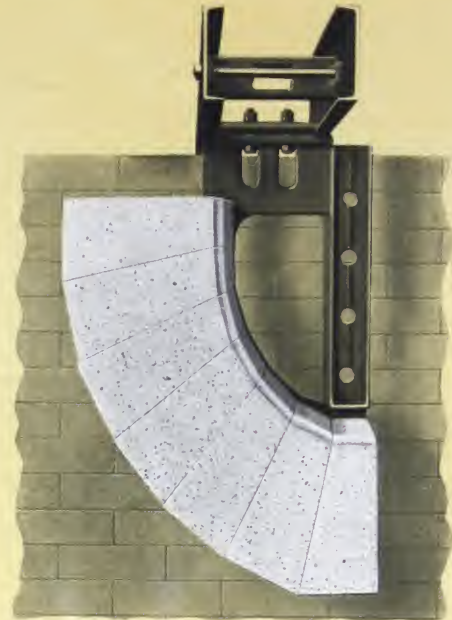
*Detrick Flat Arch with  
Fan Ignition Arch*







*Fan Ignition Arch Casting*



*Assembly of Fan Ignition Arch*



*End Construction Showing Method of Hanging Tile*

*Front View of Arch Showing Method of Suspending Arch Castings and Tile*







As shown between the two middle beams in the illustration on page 6, every arch more than 7 feet 6 inches in length has one or more drop hanger castings near the center. This casting supports one or more tile and rests on the adjacent tile. It can be lifted out of place from above, with the tile, so that access may easily and quickly be had to any section of the arch when repairs are necessary.

With the forced draft traveling grate stoker, the main arch is set at a considerable height above the grate in order to obtain sufficient furnace volume. In addition, some form of short arch is required at the front of the furnace to aid ignition and to protect the stoker front. This led to the design of a fan-shaped arch, which is constructed independently of the main arch. It consists of a beam spanning the front end of the furnace, from which are hung fan-shaped, cast-iron arch-bars. Tile of one standard wedge shape are hung on these arch-bars, so that the entire arch is in the shape of a fan. The advantage of this construction is that but one face of each tile is exposed to the fire. Maximum furnace volume is allowed close to the gate and ignition of the fuel is hastened by allowing more direct lines of reflection from the main arch.

The fan arch is sometimes used at the rear of the arch because it eliminates the nose tile, which has two sides exposed to the fire. Tile in the fan arch have only one side exposed to the fire, allowing for more uniform radiation.

The cracking of the surface of the brick exposed to the fire, which results in particles of the fire brick becoming separated from the body of the brick, is called spalling. It is the result of alternate cooling and heating of the brick. The amount of spalling that will occur is dependent upon the quality of the mixture and grind and the degree to which it has been burned.

All tile used in Detrick Arches are made of the highest grade refractory material and have the proper refractory qualities to withstand extreme temperatures. These tile are all carefully inspected for workmanship, size, shape, mixture, grind and burn. Any tile not meeting the Detrick specifications are immediately rejected at the tile plant. Rigid specifications and careful inspection result in the use of the best grade of material and the best workmanship obtainable in the making of Detrick Arch tile.

Detrick Arch tile are small. A small tile can be burned more thoroughly than a large tile. Spalling is therefore minimized because of the material and workmanship and of the small tile used.

In the Detrick Arch each tile is individually suspended from the arch-bar. There is no strain on the tile due to the expansion or contraction of the arch as a mass, as proper provision is made for this expansion in the installation of these arches. The following pages show Detrick Arches installed with many different combinations of boilers and stokers, as well as with special furnaces of various types.



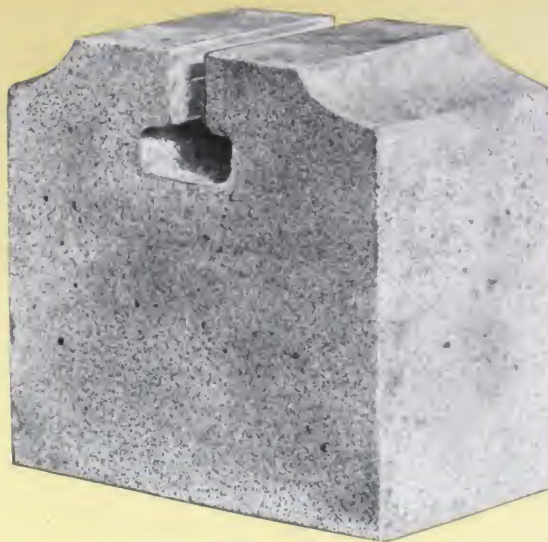


DETRICK

ARCHES



*No. 13 Tile*



*No. 1 Tile*



*No. S-12 Tile*



*No. 7 Tile*



*No. 6 Tile*



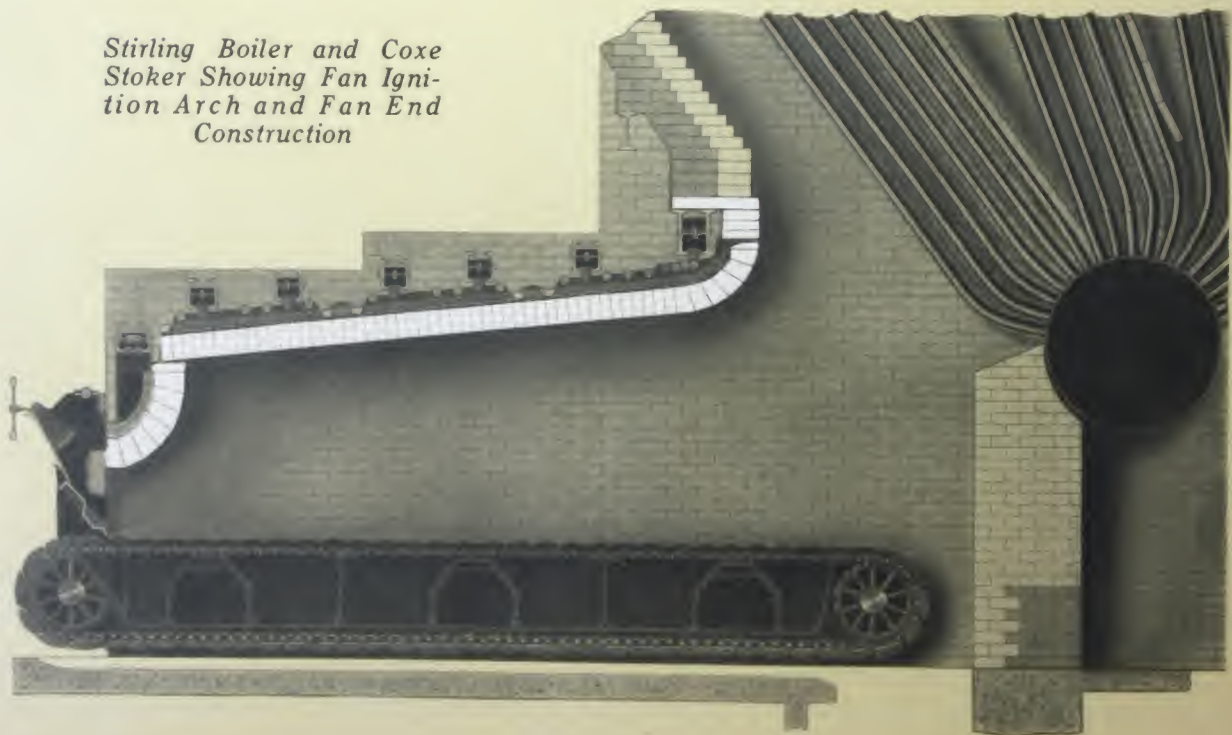
## Detrick Arches with Forced Draft Traveling Grate Stokers

**D**ETRICK Arches are used extensively in connection with forced draft traveling grate stokers because of their adaptability to various furnace conditions and simplicity of construction.

In connection with this type of stoker, arches are called upon to meet most severe operating conditions. These furnaces are often operated up to ratings of 300 per cent of the rated boiler capacity. Temperatures in the furnaces will at times exceed 2,700 degrees F. Pressures up to one-tenth of an inch are often carried in the furnace for three and four hours. Detrick Arches have withstood this service over long periods of time.

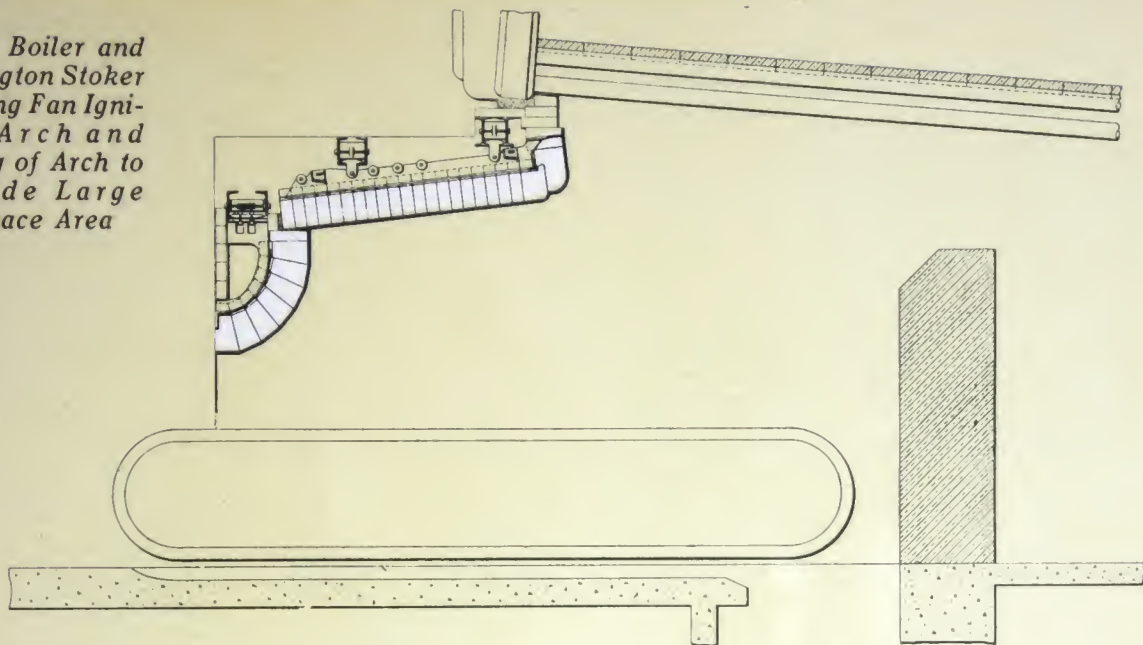
The high capacities and efficiencies that this type of stoker is giving are due to a considerable extent to the proper design and setting of the arch.

*Stirling Boiler and Coxe  
Stoker Showing Fan Igni-  
tion Arch and Fan End  
Construction*

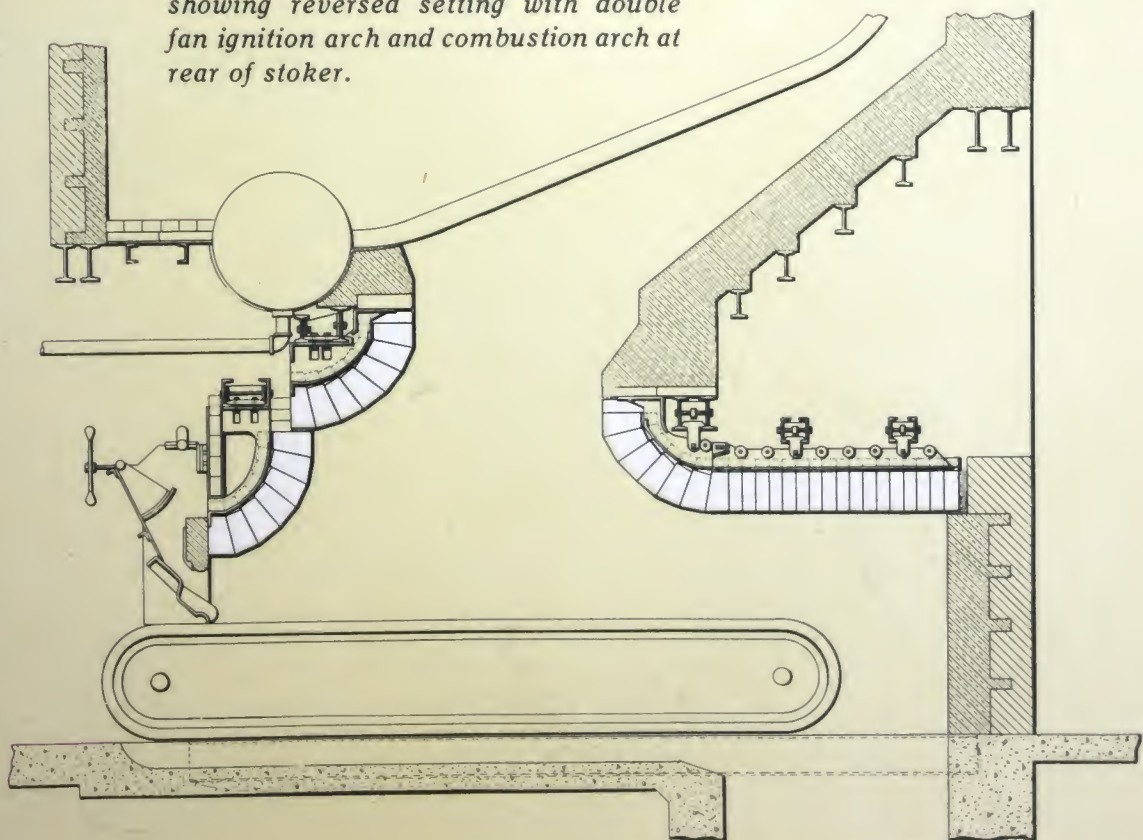




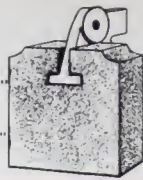
*Heine Boiler and  
Harrington Stoker  
Showing Fan Igni-  
tion Arch and  
Setting of Arch to  
Provide Large  
Furnace Area*



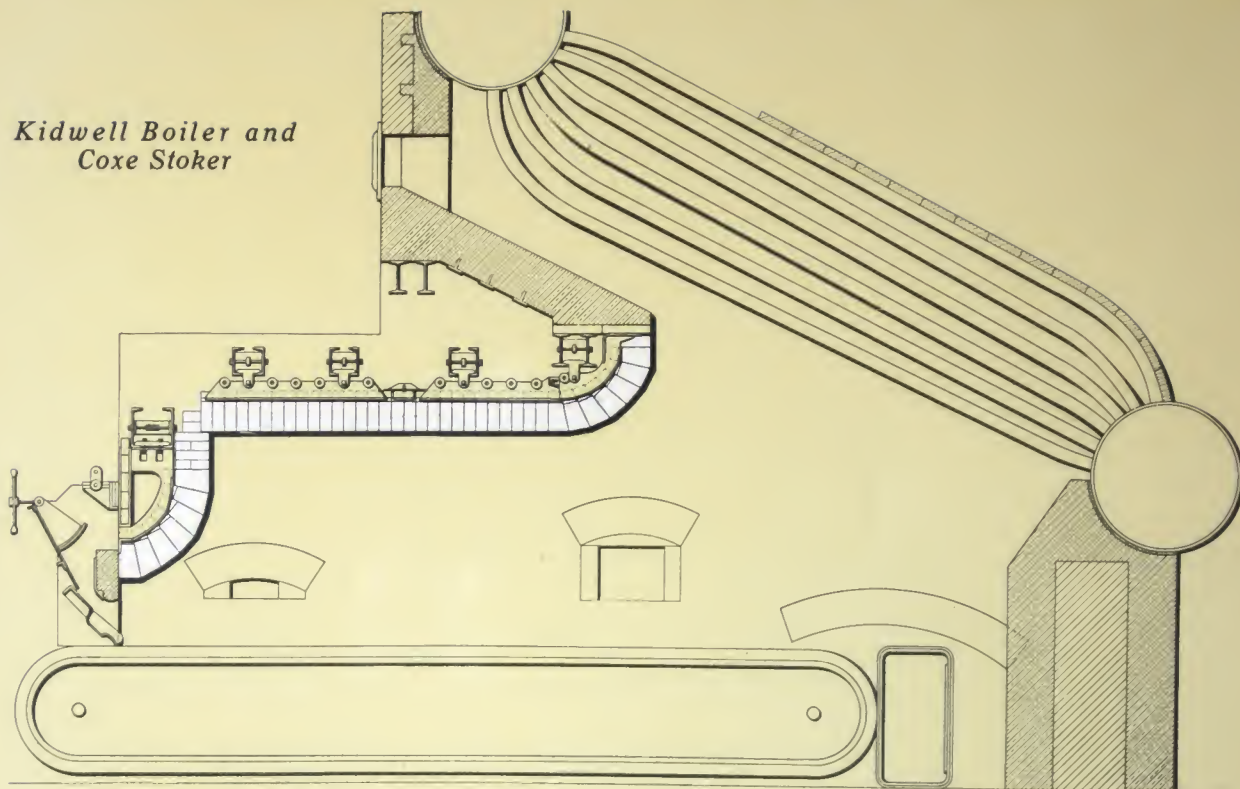
*Badenhausen Boiler and Coxe Stoker  
showing reversed setting with double  
fan ignition arch and combustion arch at  
rear of stoker.*



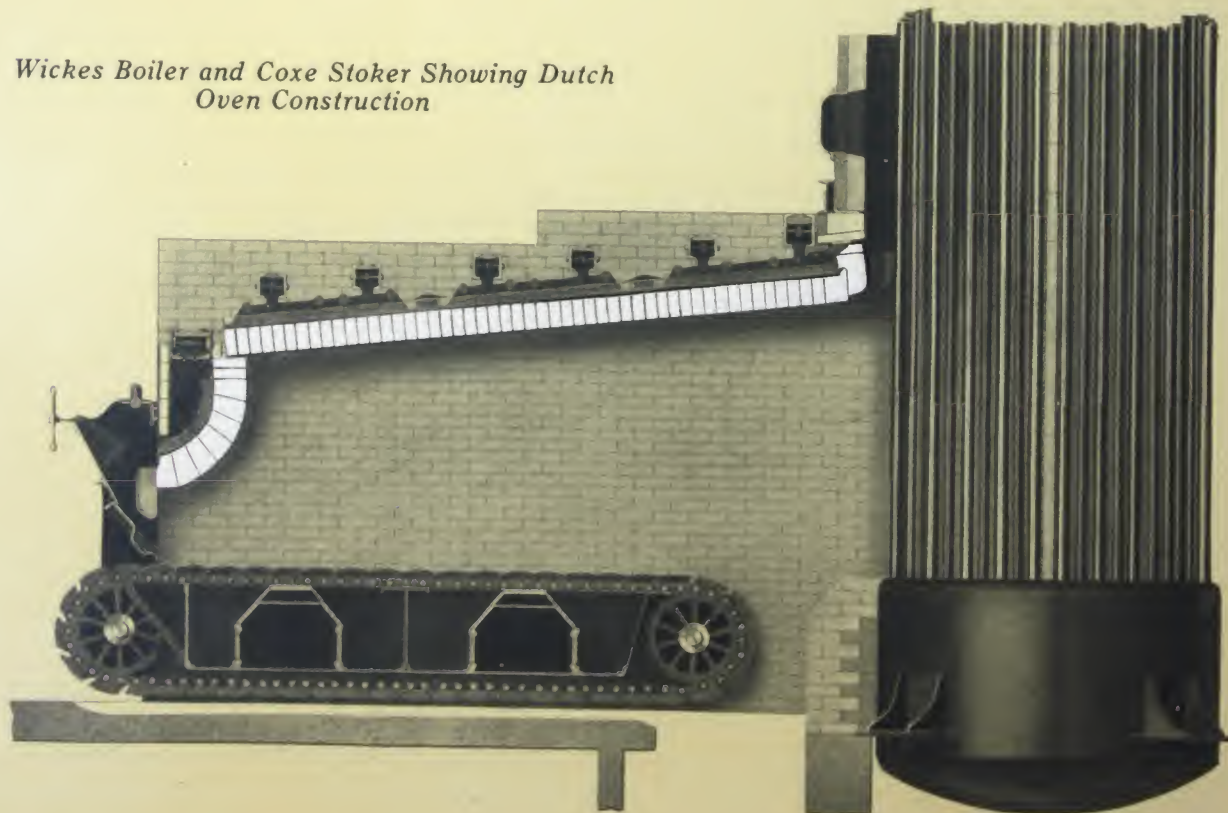




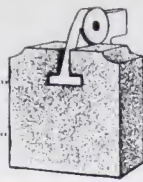
*Kidwell Boiler and  
Coxe Stoker*



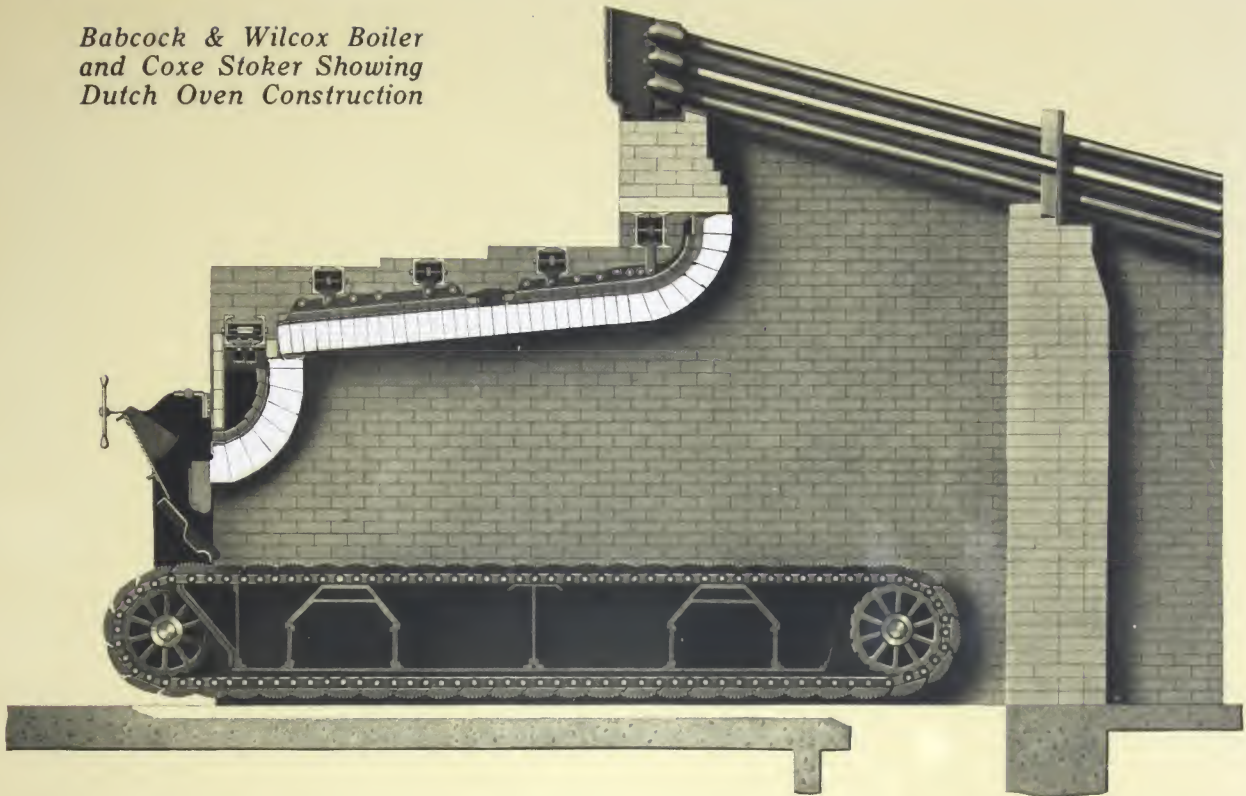
*Wickes Boiler and Coxe Stoker Showing Dutch  
Oven Construction*





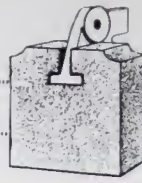


*Babcock & Wilcox Boiler  
and Coxe Stoker Showing  
Dutch Oven Construction*



*A Coxe Stoker Installation Where Detrick Arches Are Used*





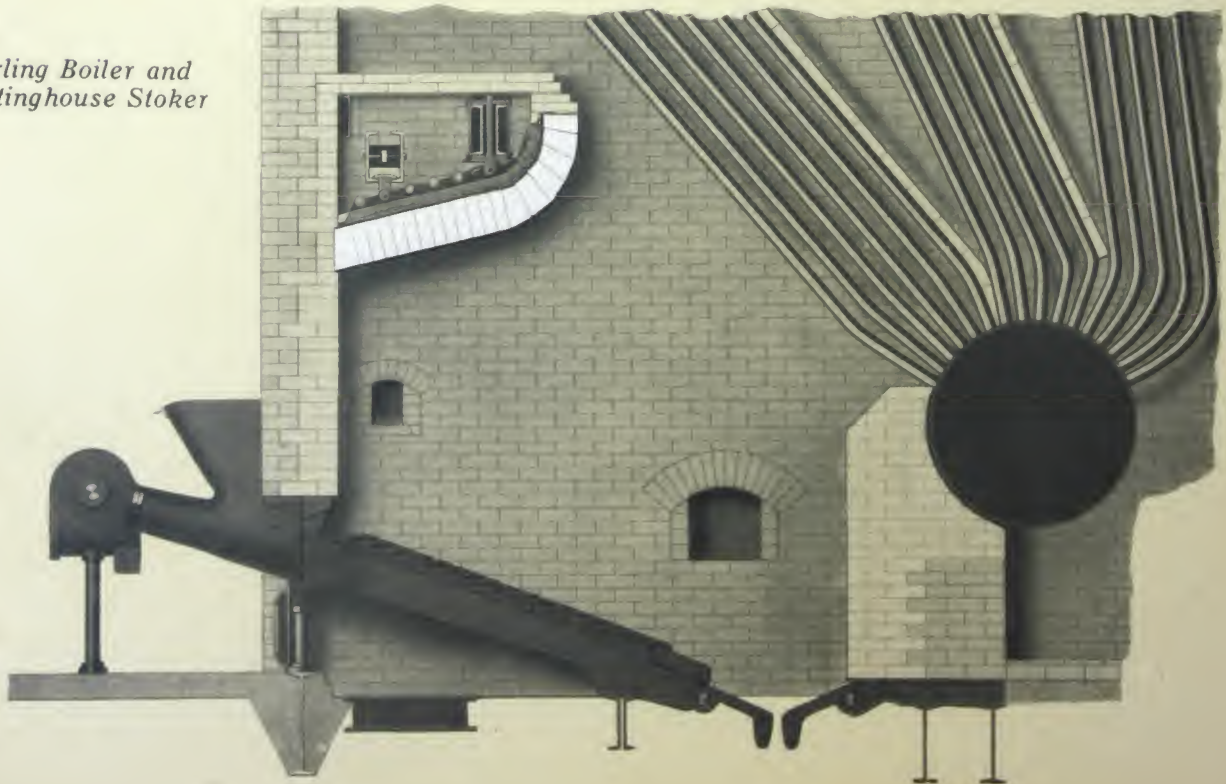
## Detrick Arches with Under-Feed Stokers

THE customary operation of under-feed stokers has been at high overloads for great lengths of time with consequent high furnace temperatures and severe changes in temperature when the boiler is taken off the line. Many of these furnaces are operated at 300 per cent of boiler rating and over, and furnace temperatures over 2,700 degrees F. are often obtained. This service is extremely hard on any arch.

In the application of under-feed stokers to boilers it is often necessary to design special front wall or bridge wall construction. Detrick Arches have been successfully used for these purposes.

The arch was a cause of trouble to operating engineers in connection with under-feed stokers, especially where large Dutch ovens were necessary, as in the case of vertical water tube boilers. Detrick Arches, however, have overcome these troubles. Maintenance has been kept low and the arch has been a factor in increasing the efficiency of the furnace.

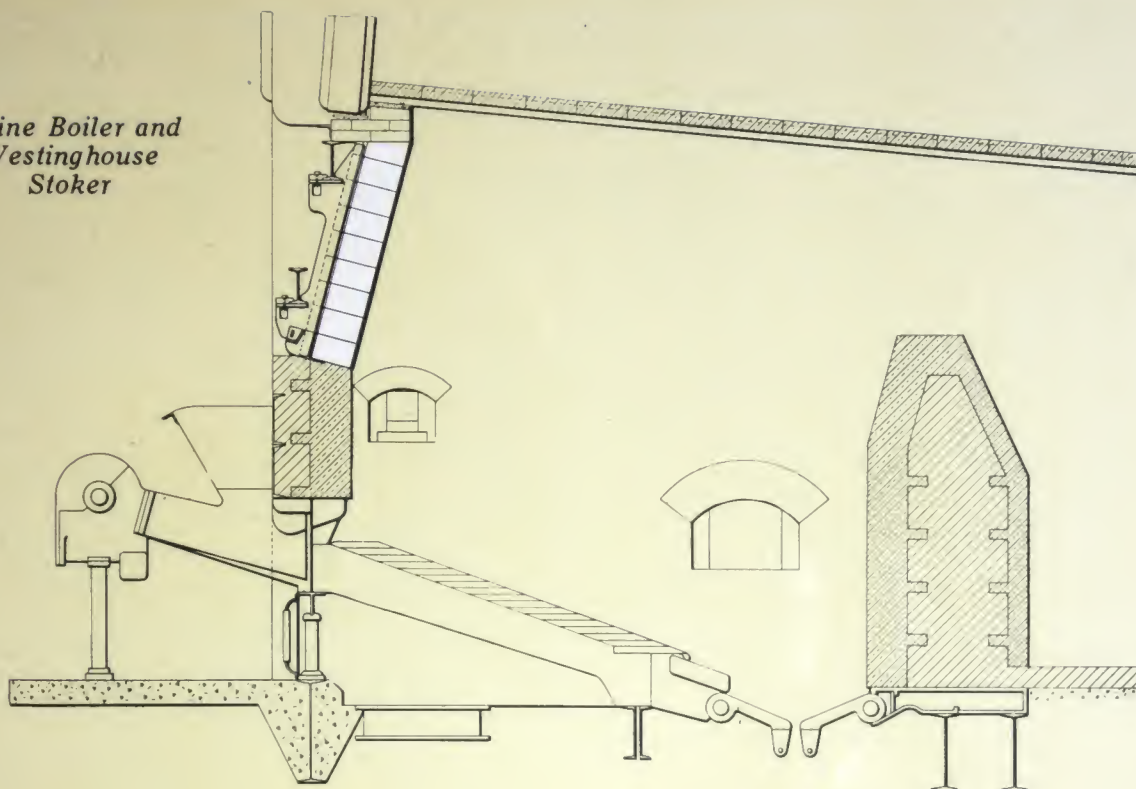
*Stirling Boiler and  
Westinghouse Stoker*



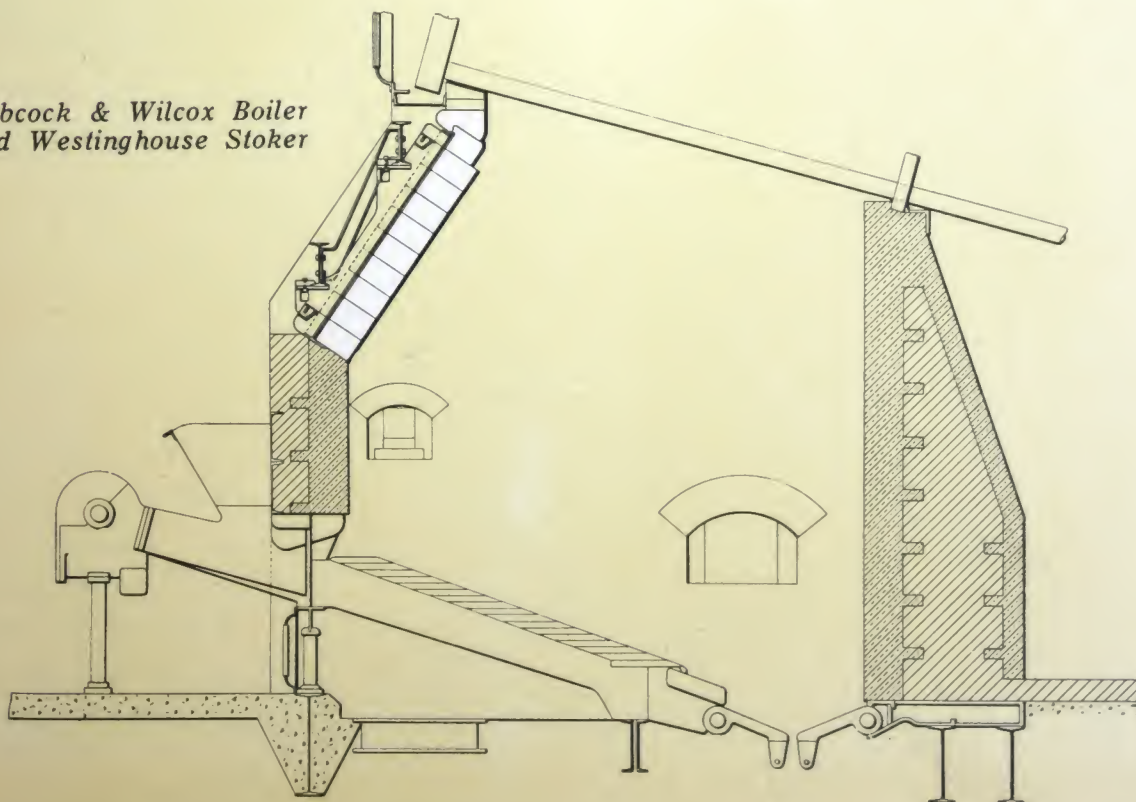




*Heine Boiler and  
Westinghouse  
Stoker*

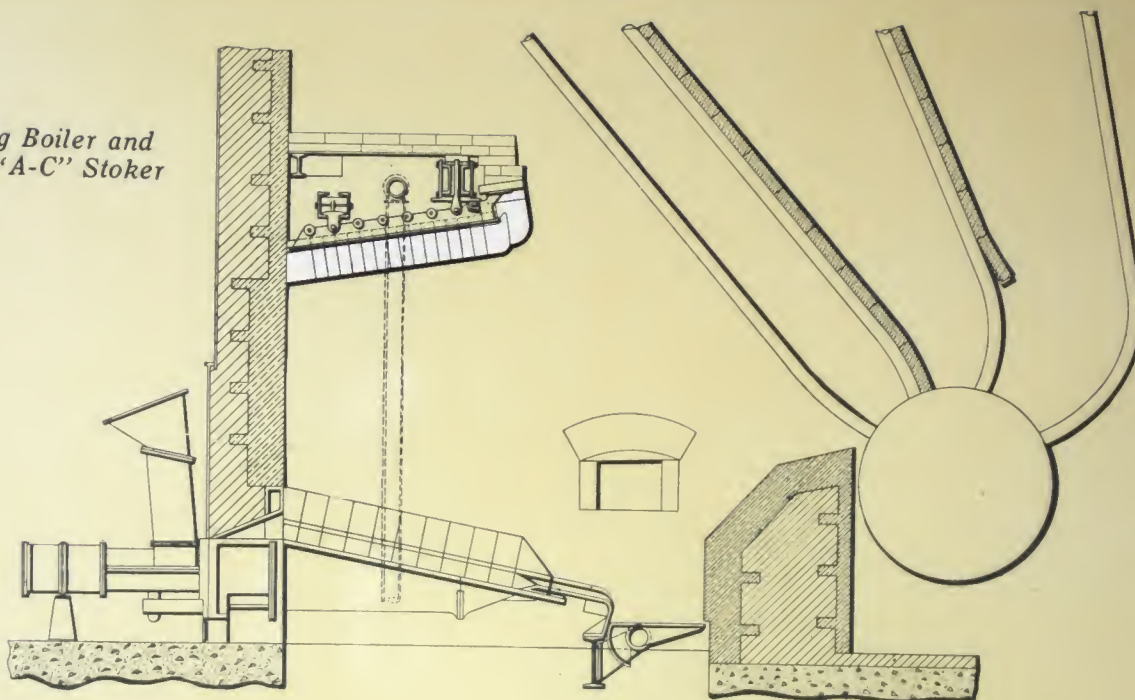


*Babcock & Wilcox Boiler  
and Westinghouse Stoker*

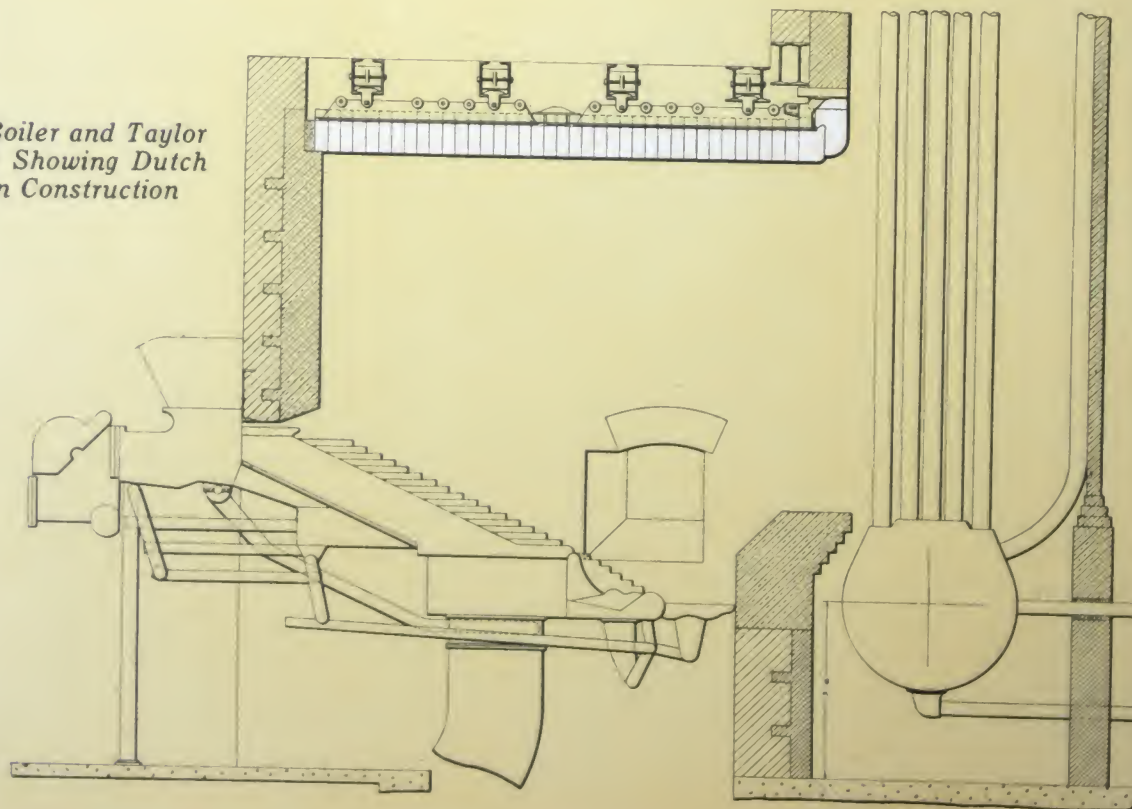




*Stirling Boiler and  
Jones "A-C" Stoker*



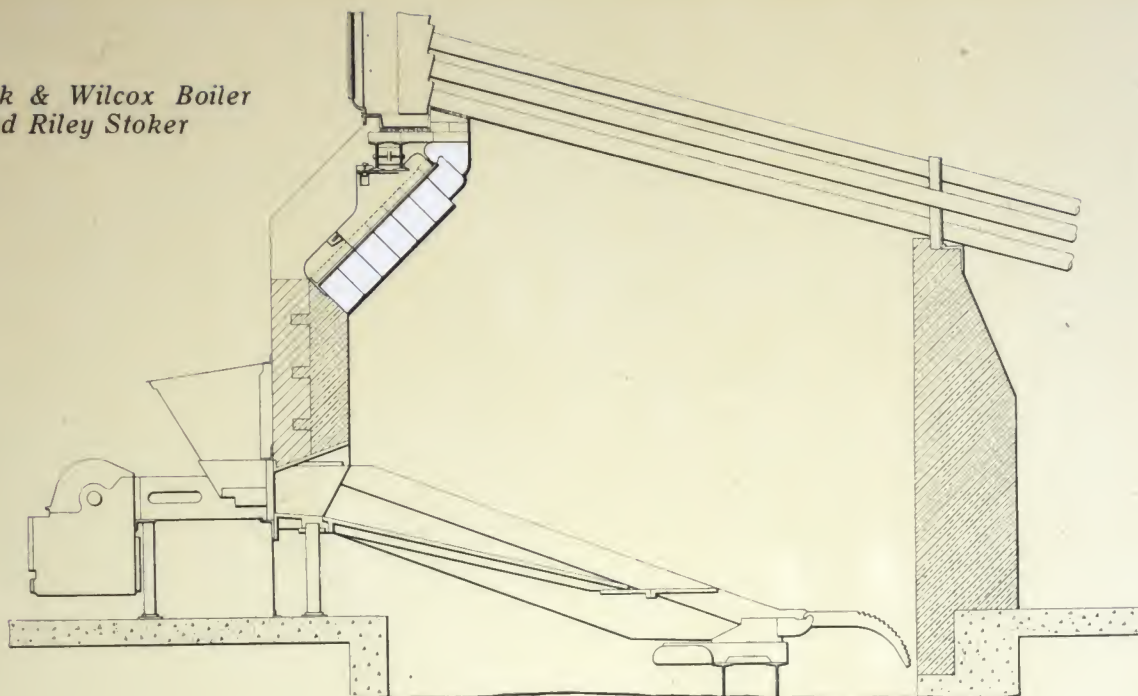
*Rust Boiler and Taylor  
Stoker Showing Dutch  
Oven Construction*



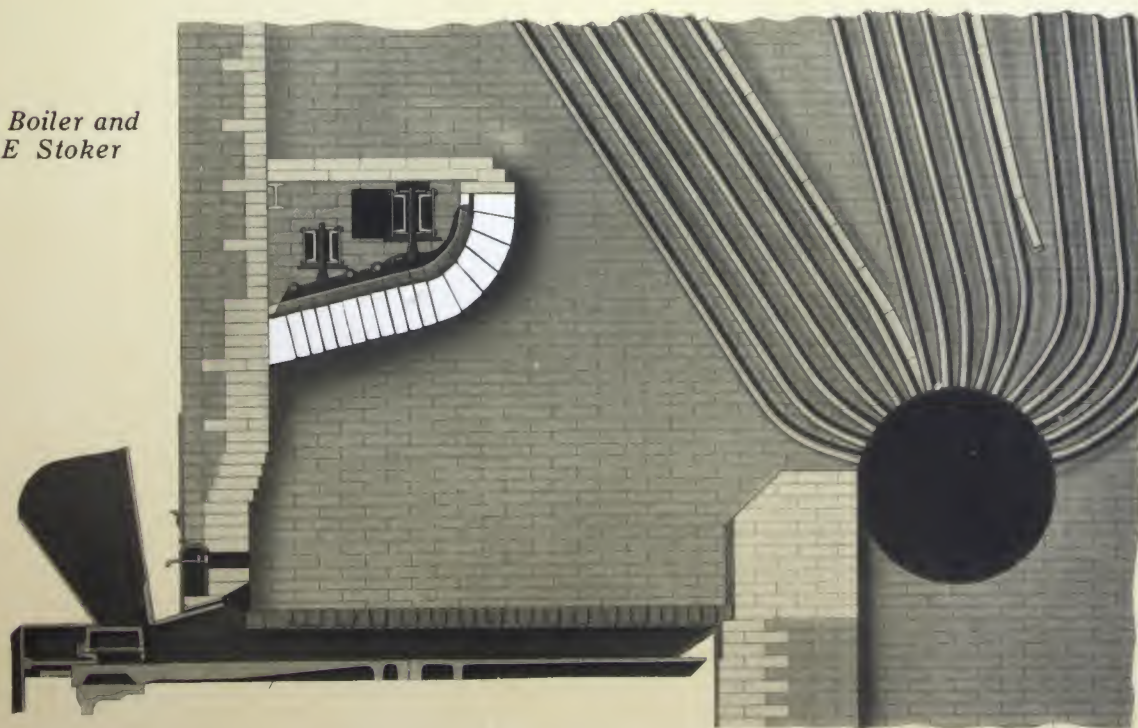




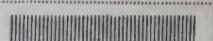
*Babcock & Wilcox Boiler  
and Riley Stoker*



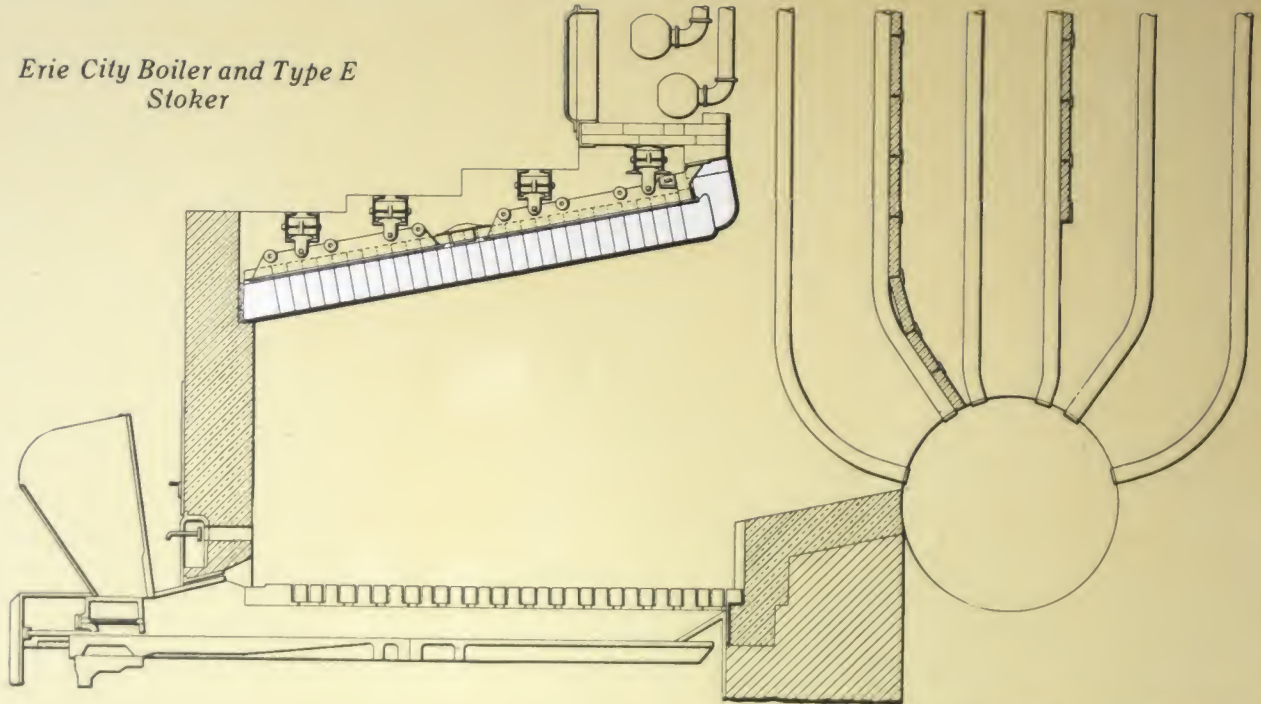
*Stirling Boiler and  
Type E Stoker*



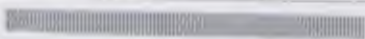
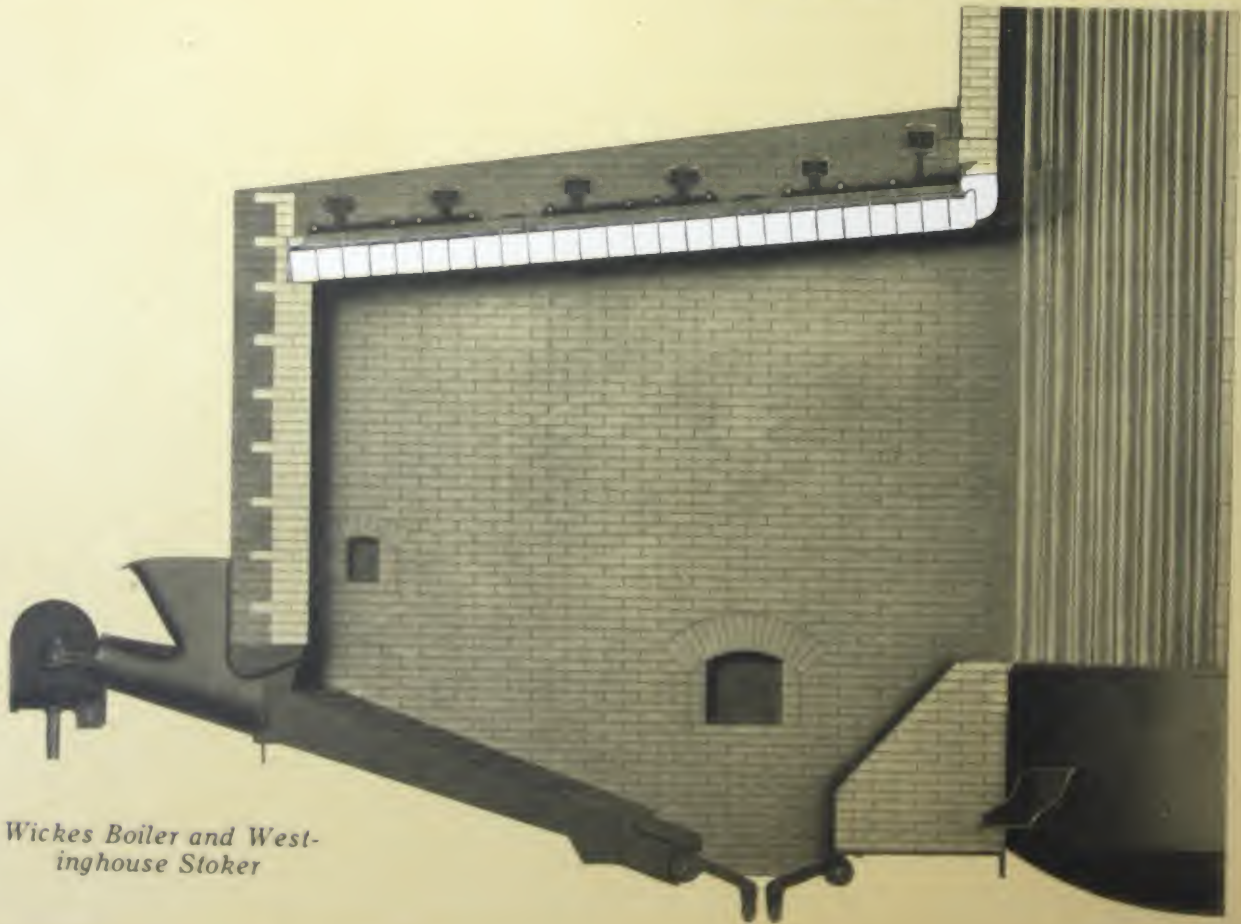




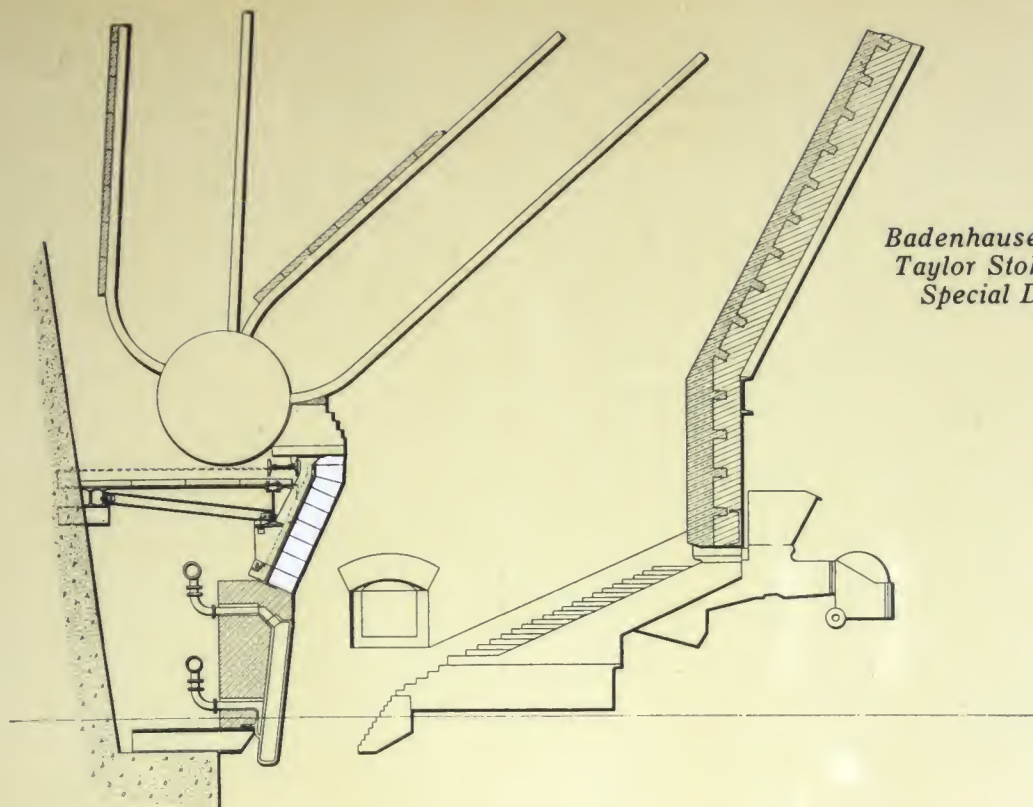
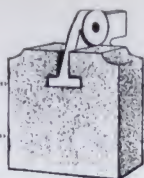
*Erie City Boiler and Type E  
Stoker*



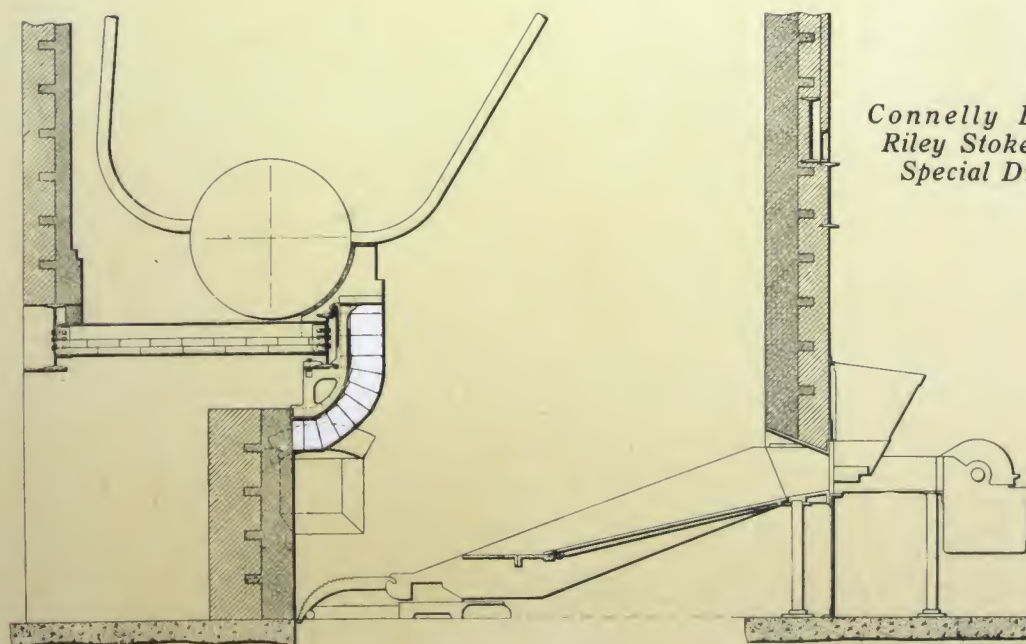
*Wickes Boiler and West-  
inghouse Stoker*







*Badenhausen Boiler and  
Taylor Stoker Showing  
Special Drum Arch*



*Connelly Boiler and  
Riley Stoker Showing  
Special Drum Arch*



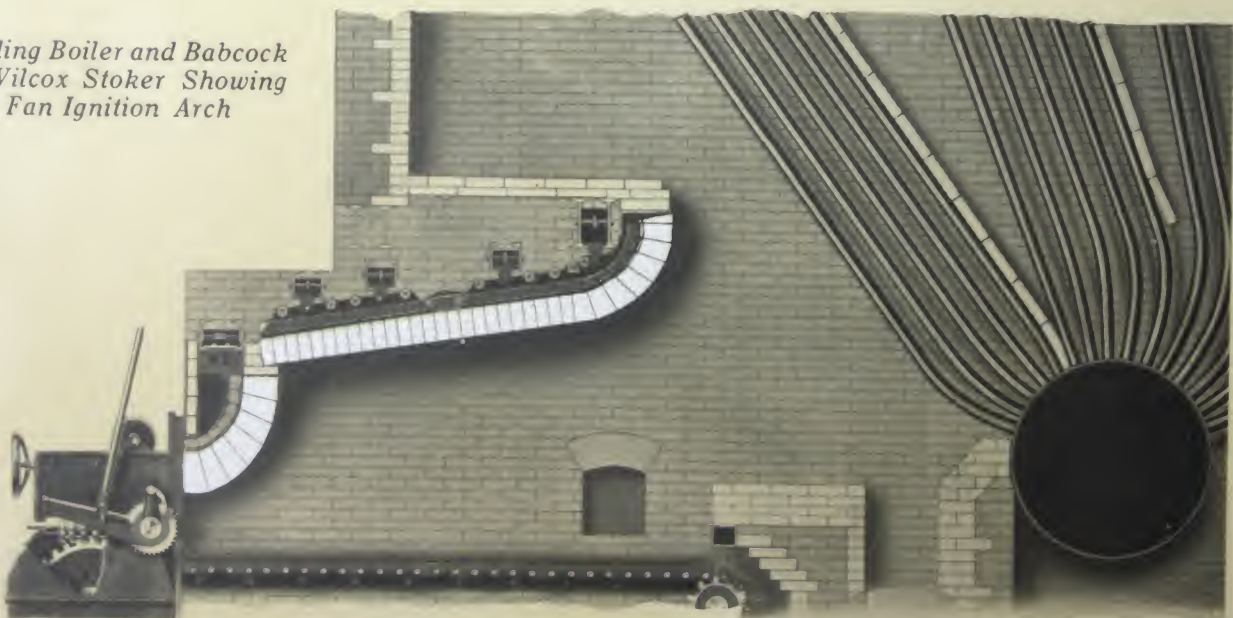


## Detrick Arches with Natural Draft Chain Grate Stokers

IN connection with natural draft chain grate stokers the arch is a necessity for ignition purposes and proper combustion. Flat suspended arches facilitate proper ignition and combustion better than any other type of arch. There are two reasons for this: One is the fact that the arch can be designed and set to meet the requirements. The other is that the flat surface provided by this type of arch allows the coal on the grates to burn more uniformly over the entire width. It also provides for a more uniform distribution of the gases to the boiler.

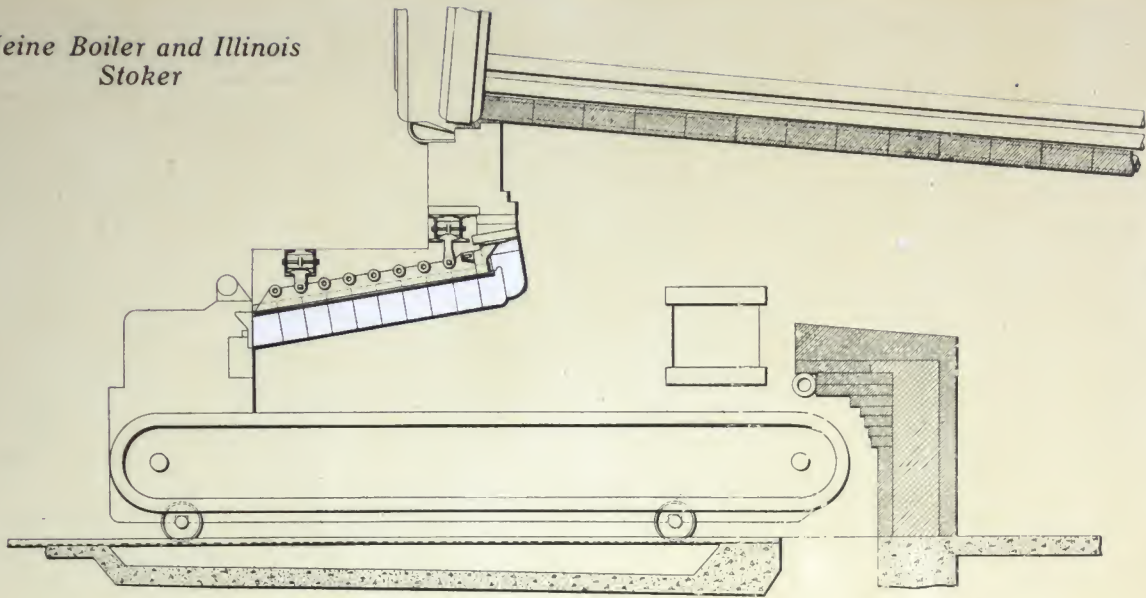
The design and setting of the flat arch as applied to this type of stoker must be determined entirely from consideration of the kind of fuel burned, the operating conditions and the type of boiler. To obtain best results each setting must be given individual attention by combustion engineers.

*Stirling Boiler and Babcock  
& Wilcox Stoker Showing  
Fan Ignition Arch*

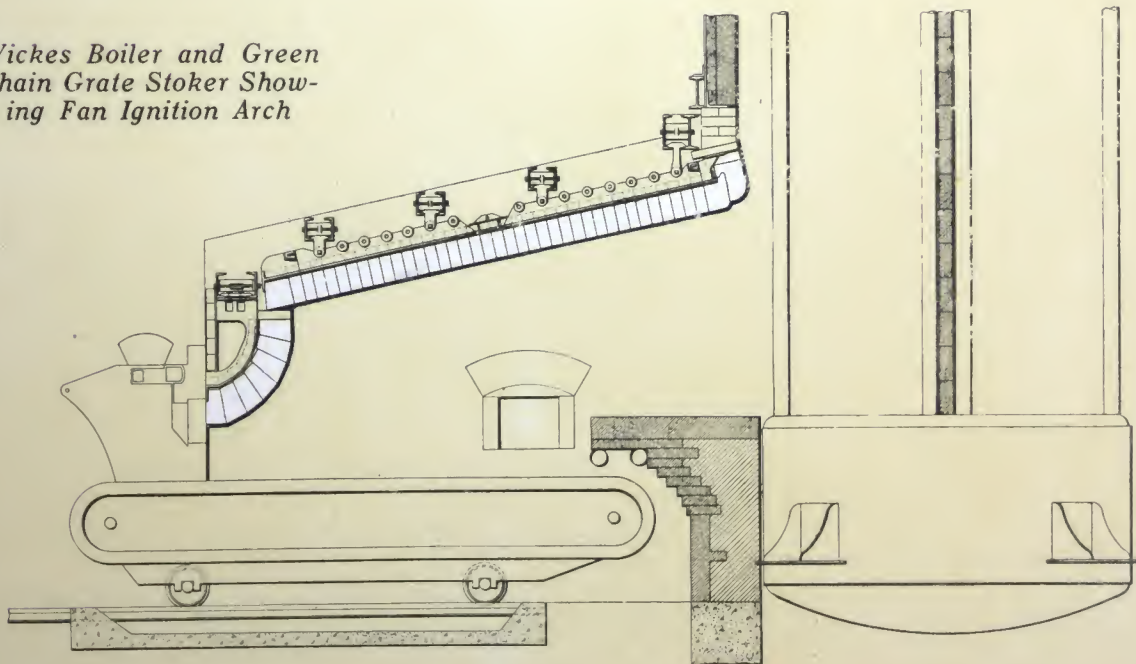




*Heine Boiler and Illinois  
Stoker*

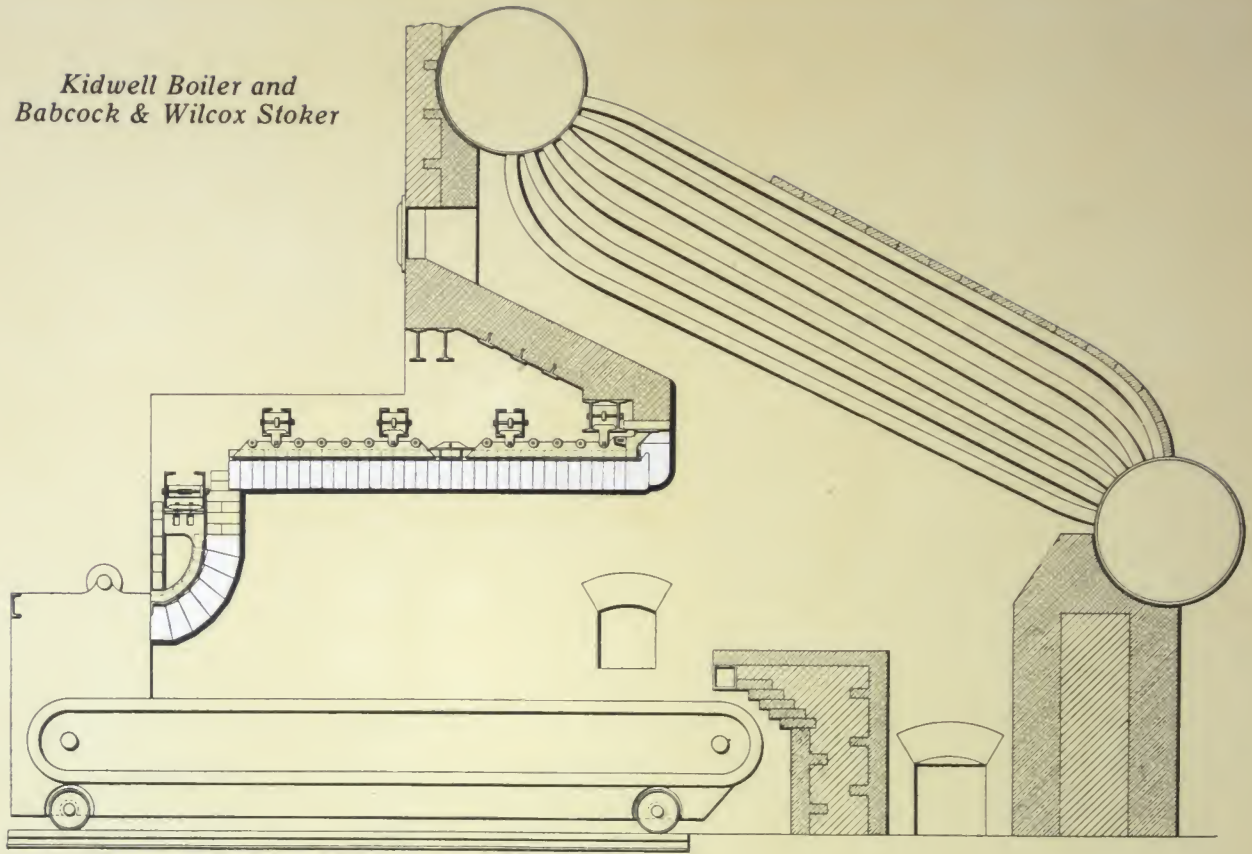


*Wickes Boiler and Green  
Chain Grate Stoker Show-  
ing Fan Ignition Arch*

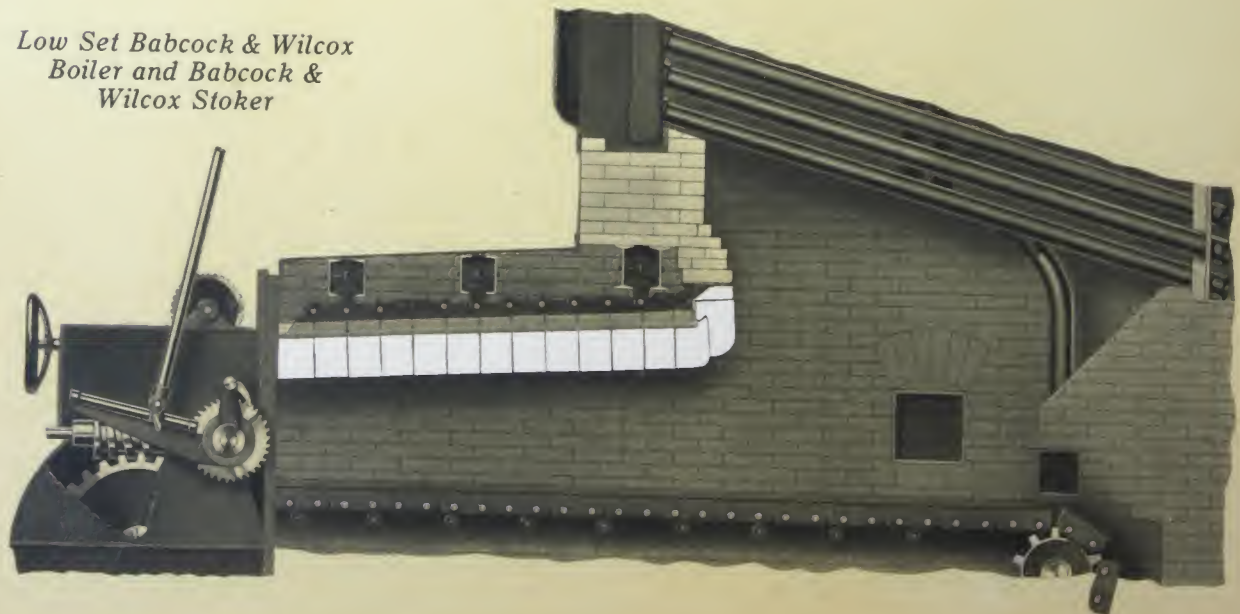




*Kidwell Boiler and  
Babcock & Wilcox Stoker*



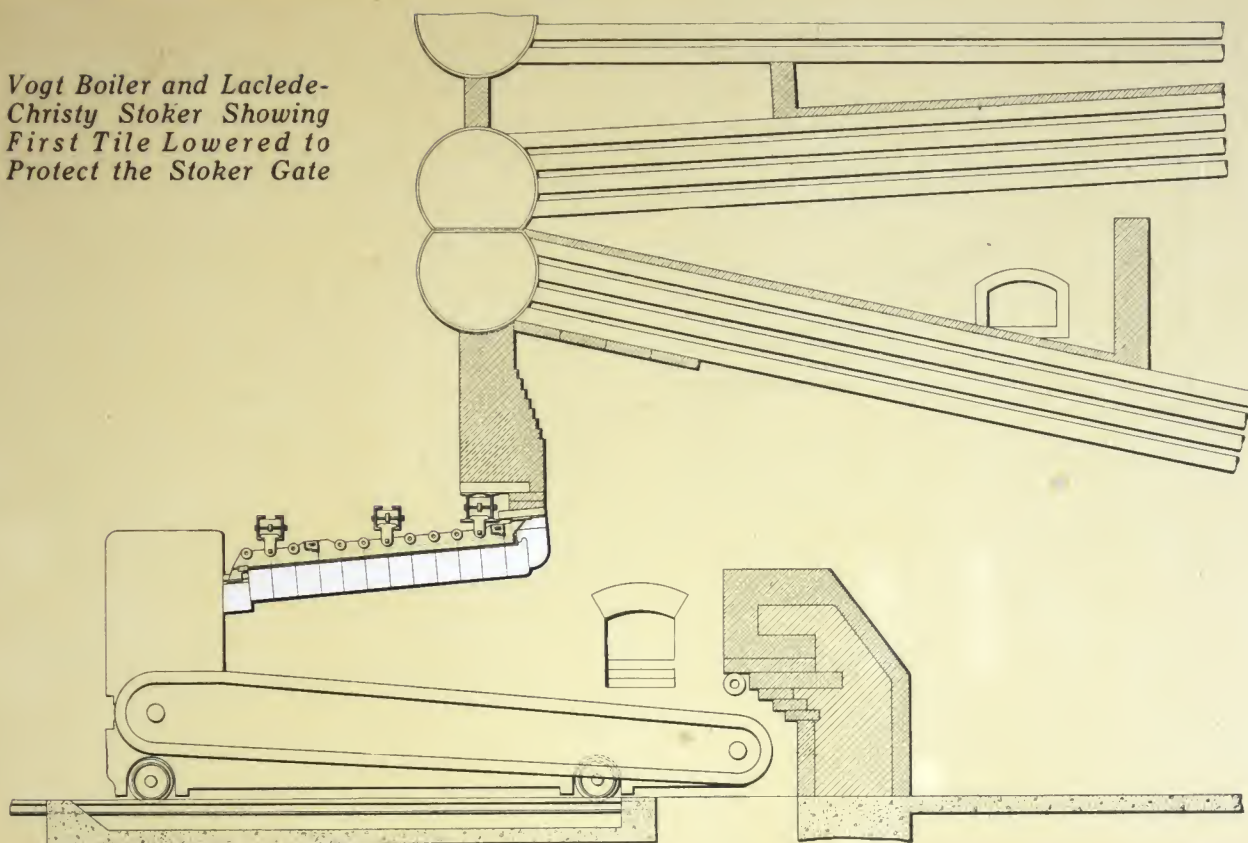
*Low Set Babcock & Wilcox  
Boiler and Babcock & Wilcox Stoker*



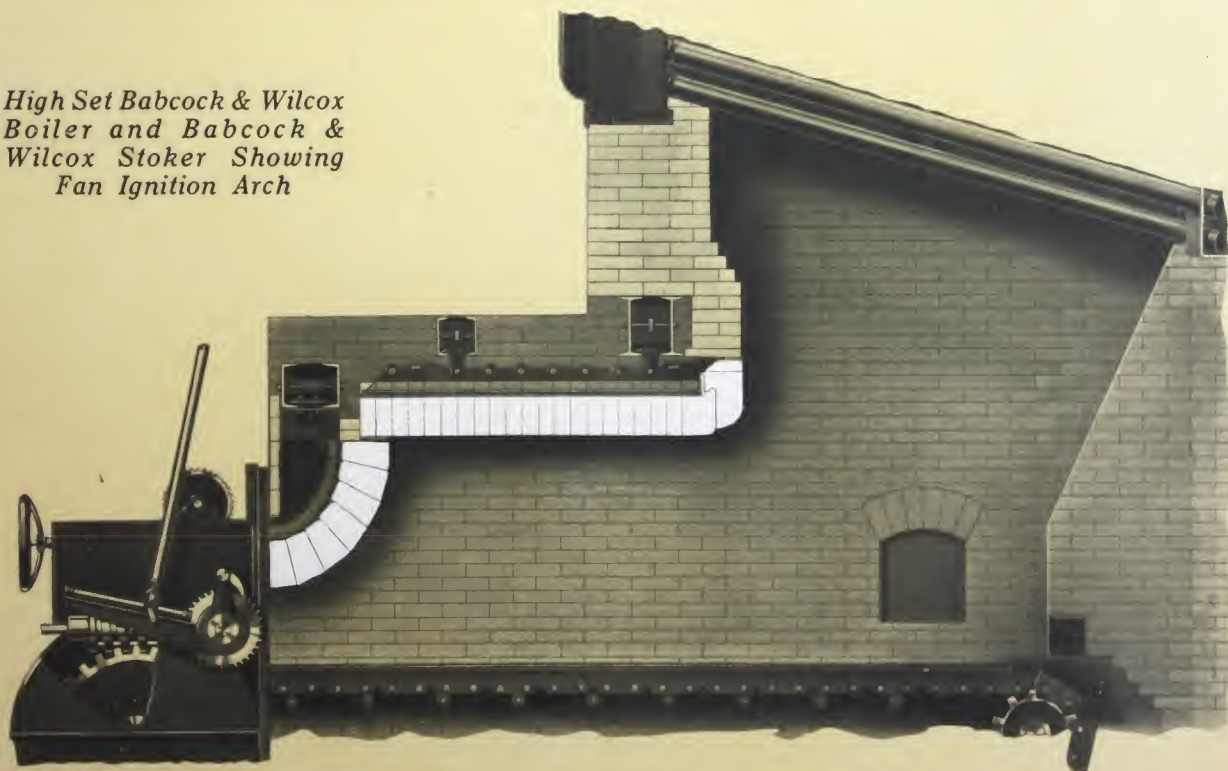




*Vogt Boiler and Laclede-Christy Stoker Showing First Tile Lowered to Protect the Stoker Gate*



*High Set Babcock & Wilcox Boiler and Babcock & Wilcox Stoker Showing Fan Ignition Arch*







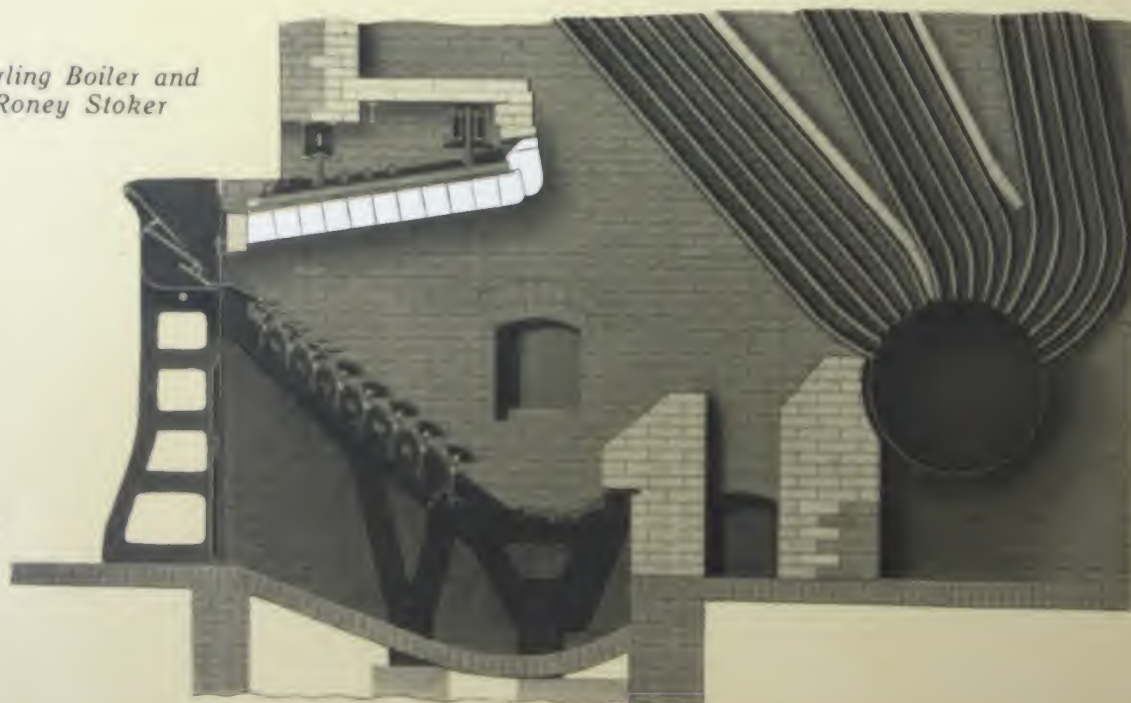
## Detrick Arches with Front Feed Inclined Stokers

**A**RCHES are a necessity with front feed inclined stokers to aid ignition and to complete combustion. Due to agitation of the fuel bed with this type of stoker high furnace temperatures are obtained.

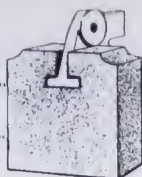
In the development of this stoker sprung arches were built up of a number of rings, each with a different radius. The rings at the front were made with a minimum pitch in order to maintain as nearly as possible a uniform distance from the coking plates to the arch. This was essential for uniform ignition across the furnace width. The pitch of the arch was gradually increased by lowering the skew-backs in order to provide a fairly substantial sprung arch construction.

The flat arch provides a flat surface as required for ignition, distributes the gases more uniformly to the boiler, and reduces maintenance costs when used with this type of stoker.

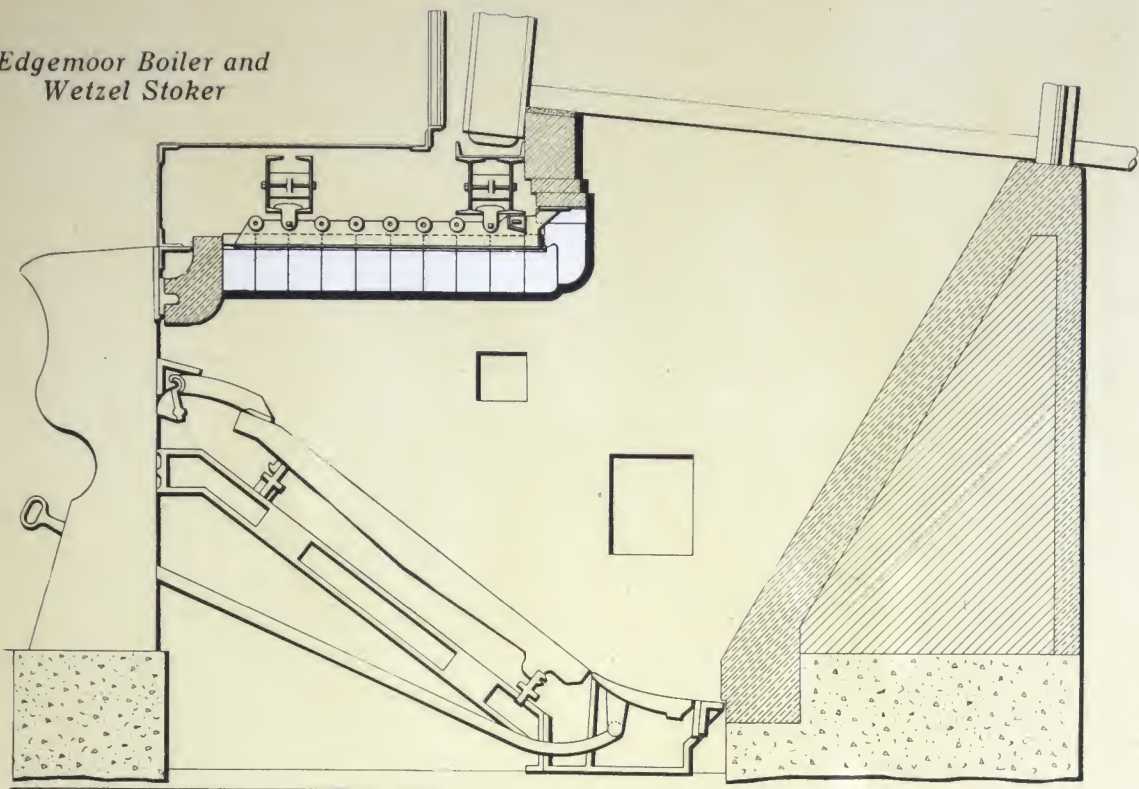
*Stirling Boiler and  
Roney Stoker*



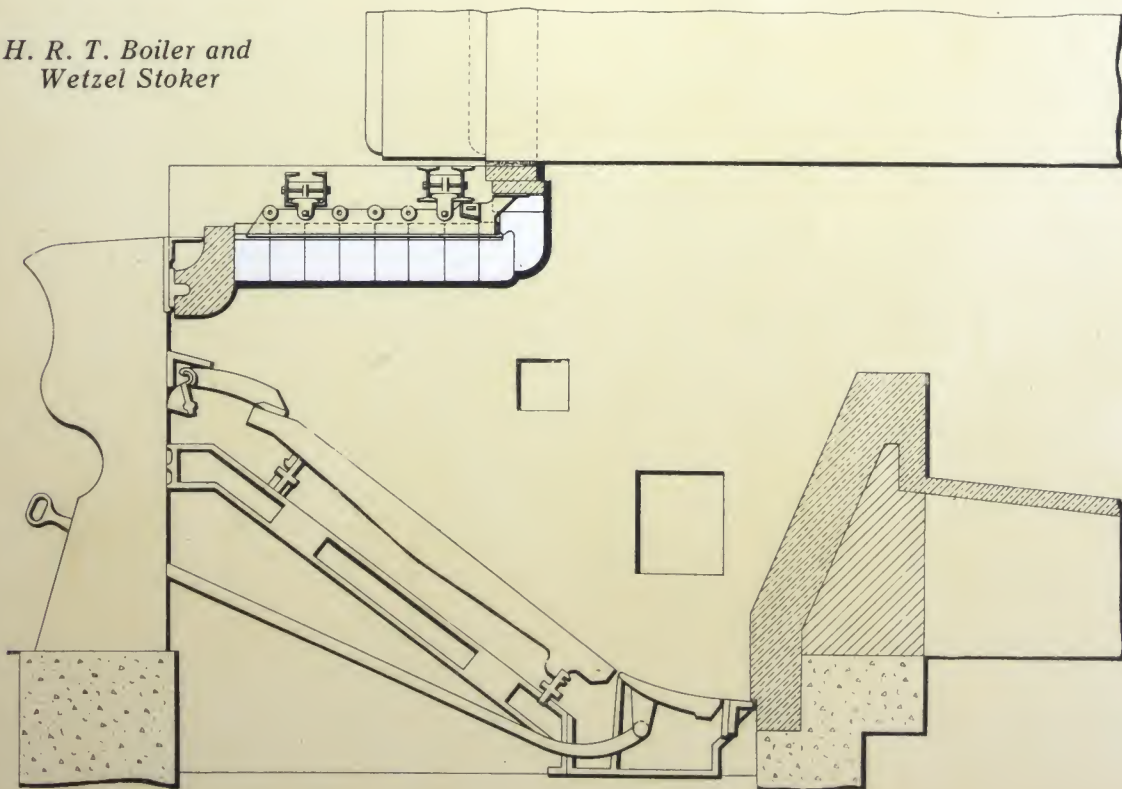




*Edgemoor Boiler and  
Wetzel Stoker*



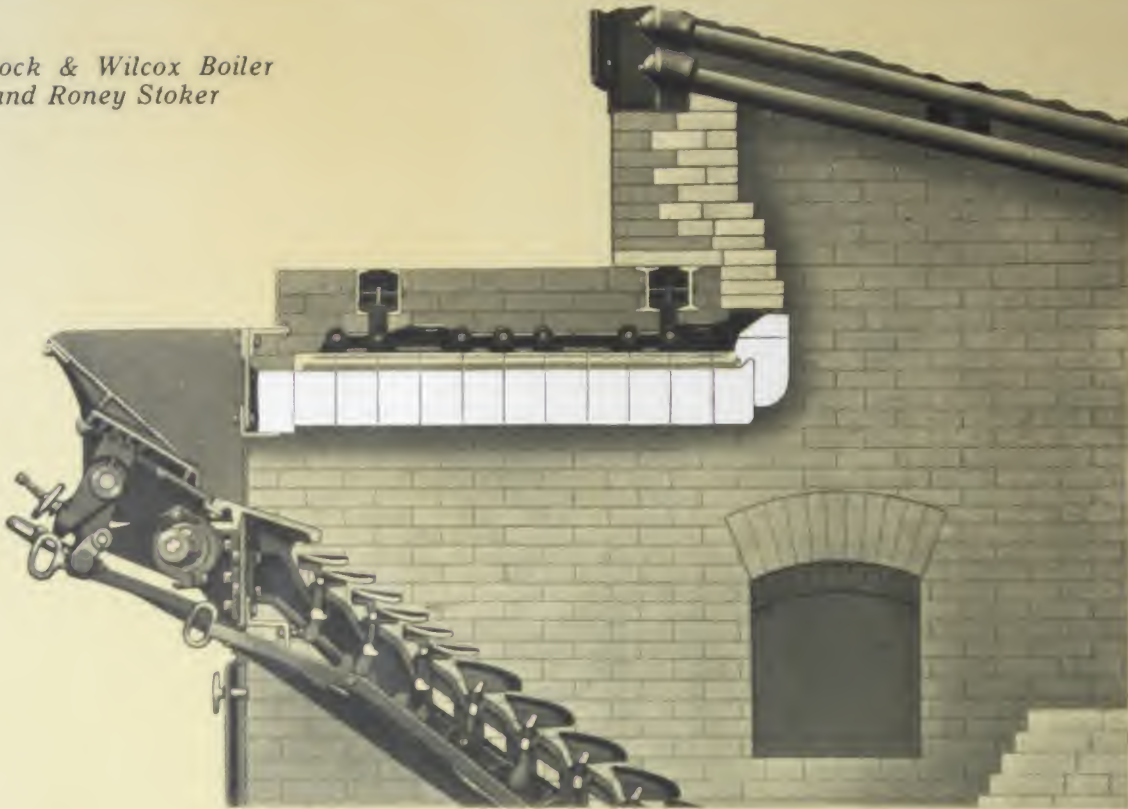
*H. R. T. Boiler and  
Wetzel Stoker*



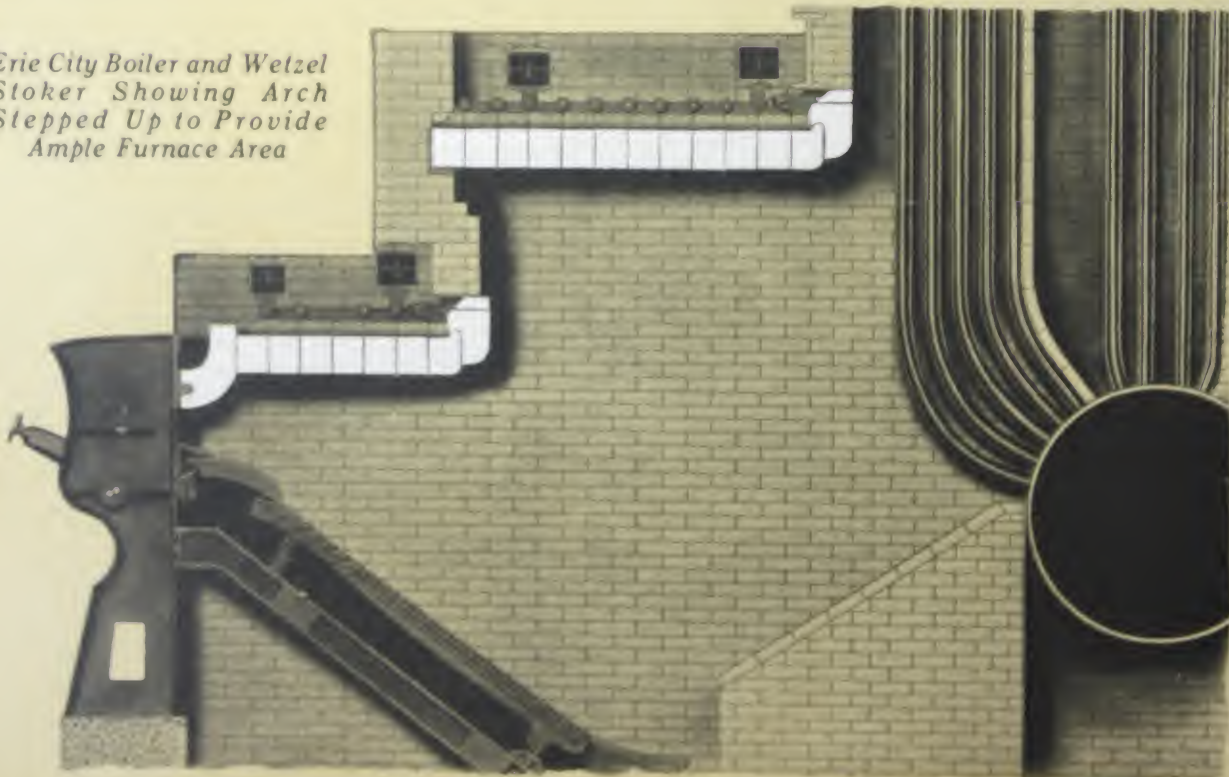




*Babcock & Wilcox Boiler  
and Roney Stoker*



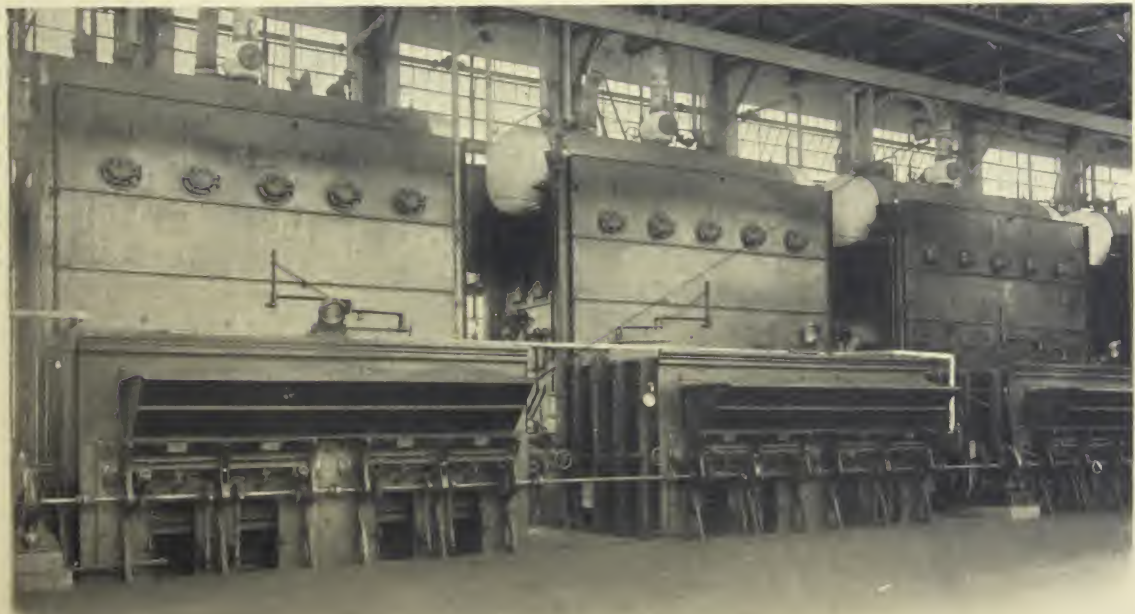
*Erie City Boiler and Wetzel  
Stoker Showing Arch  
Stepped Up to Provide  
Ample Furnace Area*







*A Roney Stoker Installation Where Detrick Arches Are Used*



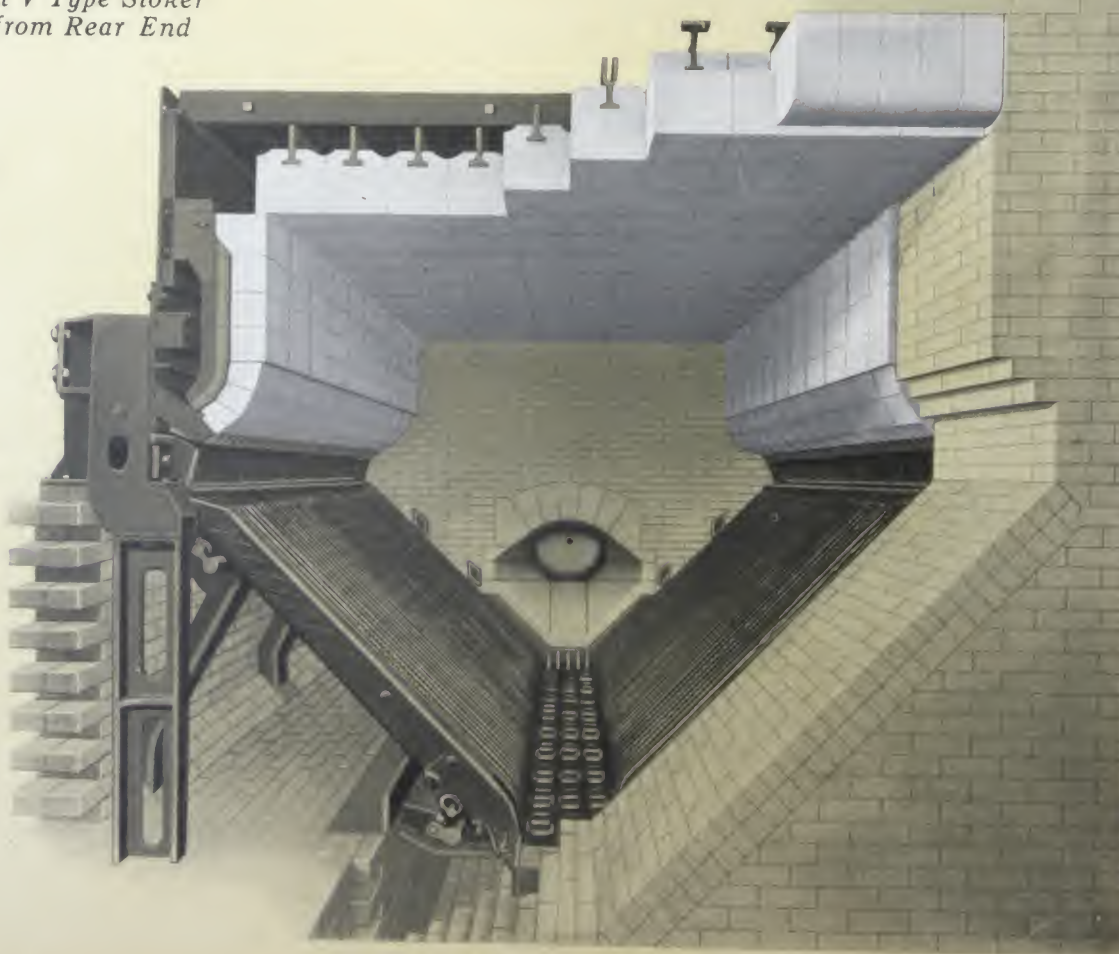
*A Wetzel Stoker Installation Where Detrick Arches Are Used*



## Detrick Arches with Side Feed Inclined Stokers

THIS stoker offers a greater problem in arch design than any other type of stoker. With other types the side wall is independent of the stoker. With this type, however, the side wall of the Dutch oven is supported on the arch plates. Detrick Arches as applied to this stoker are made up of the standard main arch and a side wall construction consisting of center-grooved tile. These tile are shaped like the fan arch tile so that only one surface is exposed to the fire, and are suspended on T-shaped vertical castings placed  $10\frac{1}{2}$  inches apart. The main arch does not rest on the side construction, but is suspended from beams supported on the side plates. A seal is made between the main arch and the side wall. The sides can be repaired without removing main arch tile. The flat surface tends to equalize the depth of the combustion chamber, and it is possible to raise the arch to any height and to obtain any desired furnace volume.

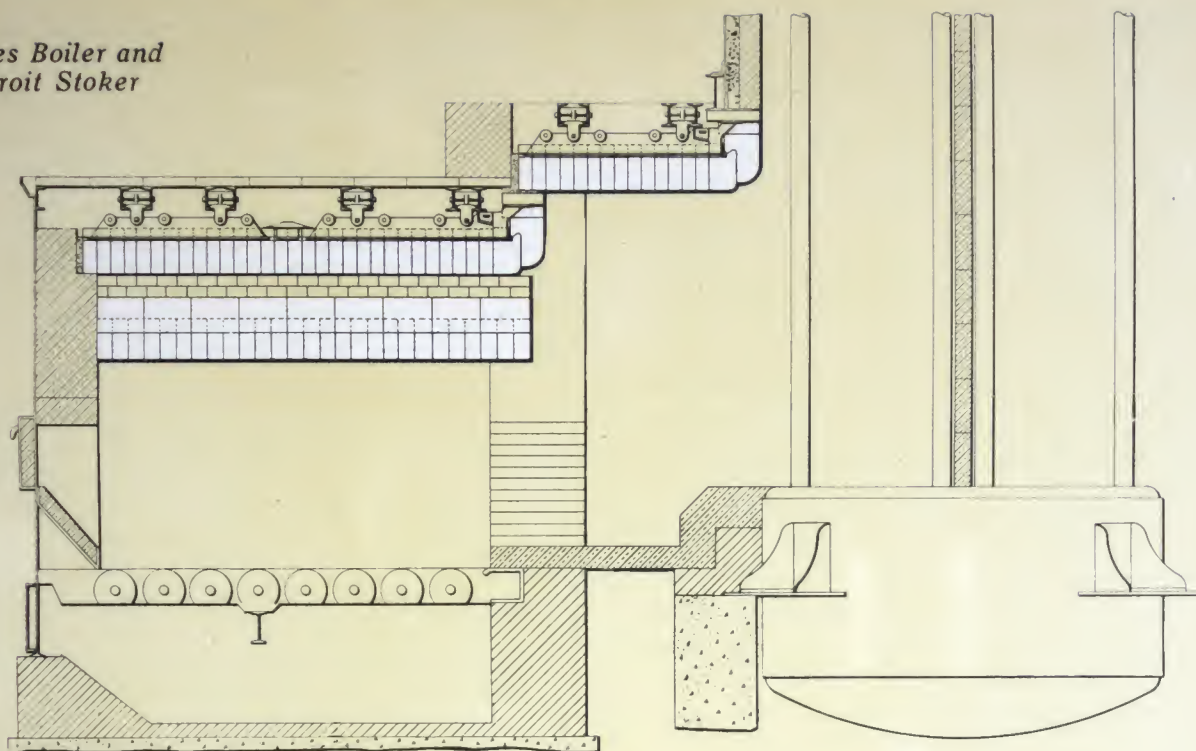
*Detroit V Type Stoker  
View from Rear End*



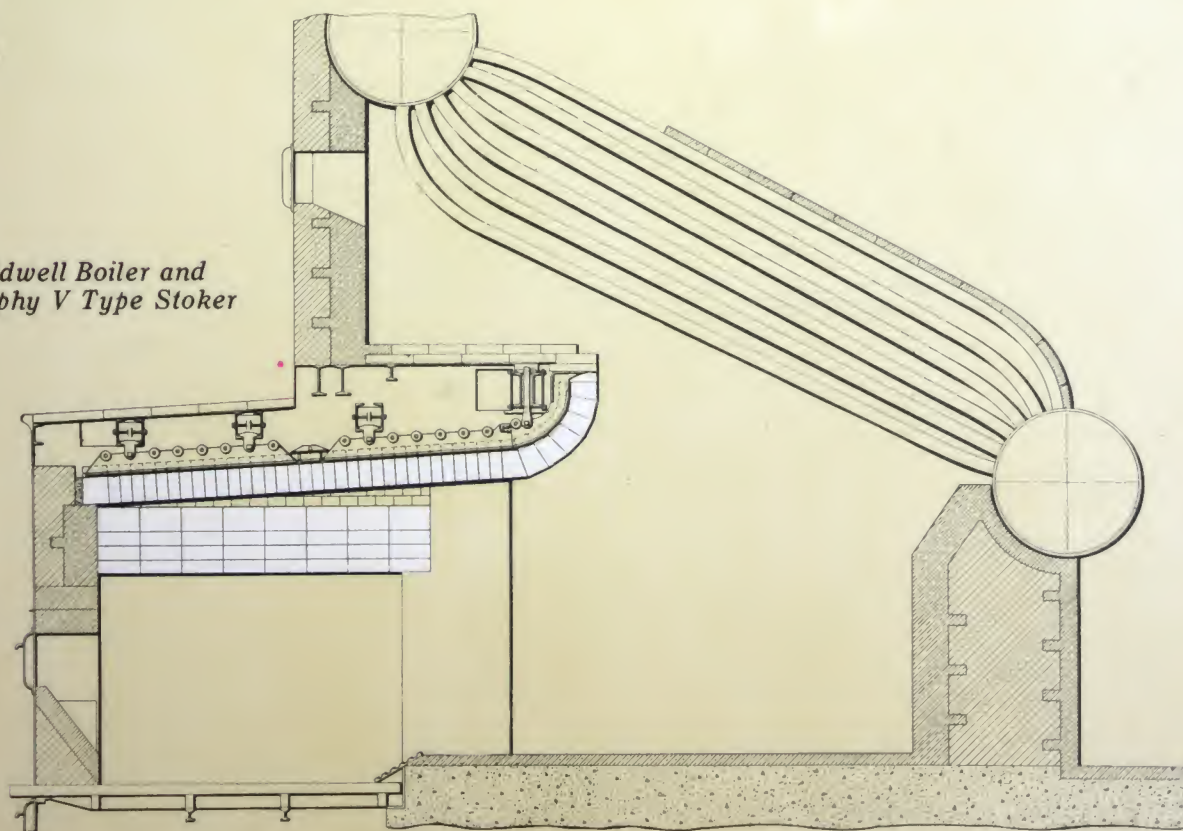




*Wickes Boiler and  
Detroit Stoker*



*Kidwell Boiler and  
Murphy V Type Stoker*







## Detrick Arches with Hand-Fired Grates

IT was customary for engineers to equip hand-fired furnaces and return tubular boiler installations with sprung arches because in most cases these furnaces were narrow and it was thought that a sprung arch would give satisfactory results. However, the demand for increased capacities and the necessity for maintenance reduction has resulted in the wide use of Detrick Arches in connection with this type of furnace.

In many plants the brick work to be done is not of sufficient amount to warrant the employment of an expert bricklayer. This type of workman is absolutely essential where sprung arches are to be used. The result has been that while no great capacities were carried on the boilers, the sprung arches failed, due to faulty workmanship.

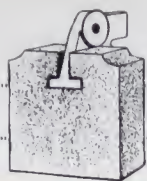
Furthermore, an arch in this type of installation is put under a heavy strain due to the operating conditions. The furnace doors are opened at frequent intervals, which allows an inrush of air which tends to cool the arch. This rapid cooling of the heated arch results in spalling of the brick.

Detrick Arches, when used in connection with this type of furnace, have not only proved satisfactory, but have eliminated the human element in putting up and repairing arches. Boiler room labor can install and repair Detrick Arches.

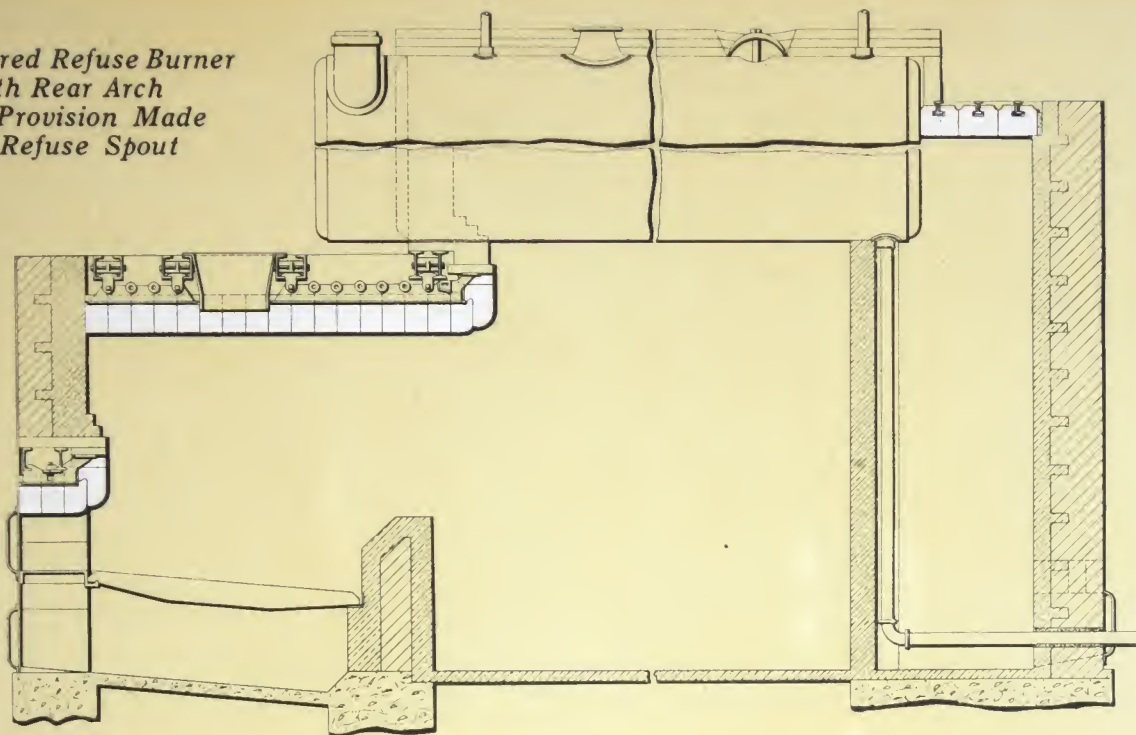
*H. R. T. Boiler and Shaking Grates  
Note the Arch Over the Fire Door  
and the Detrick Rear Arch*



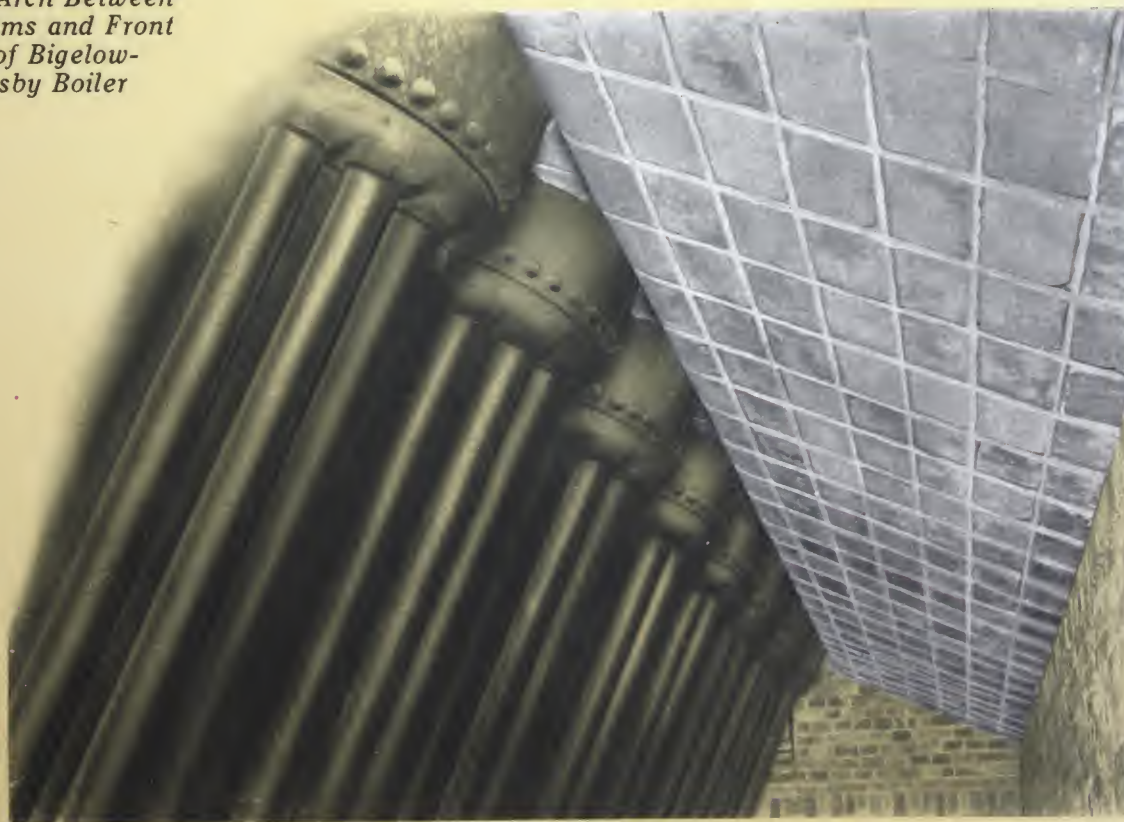




*Hand-Fired Refuse Burner  
with Rear Arch  
Note Provision Made  
for Refuse Spout*



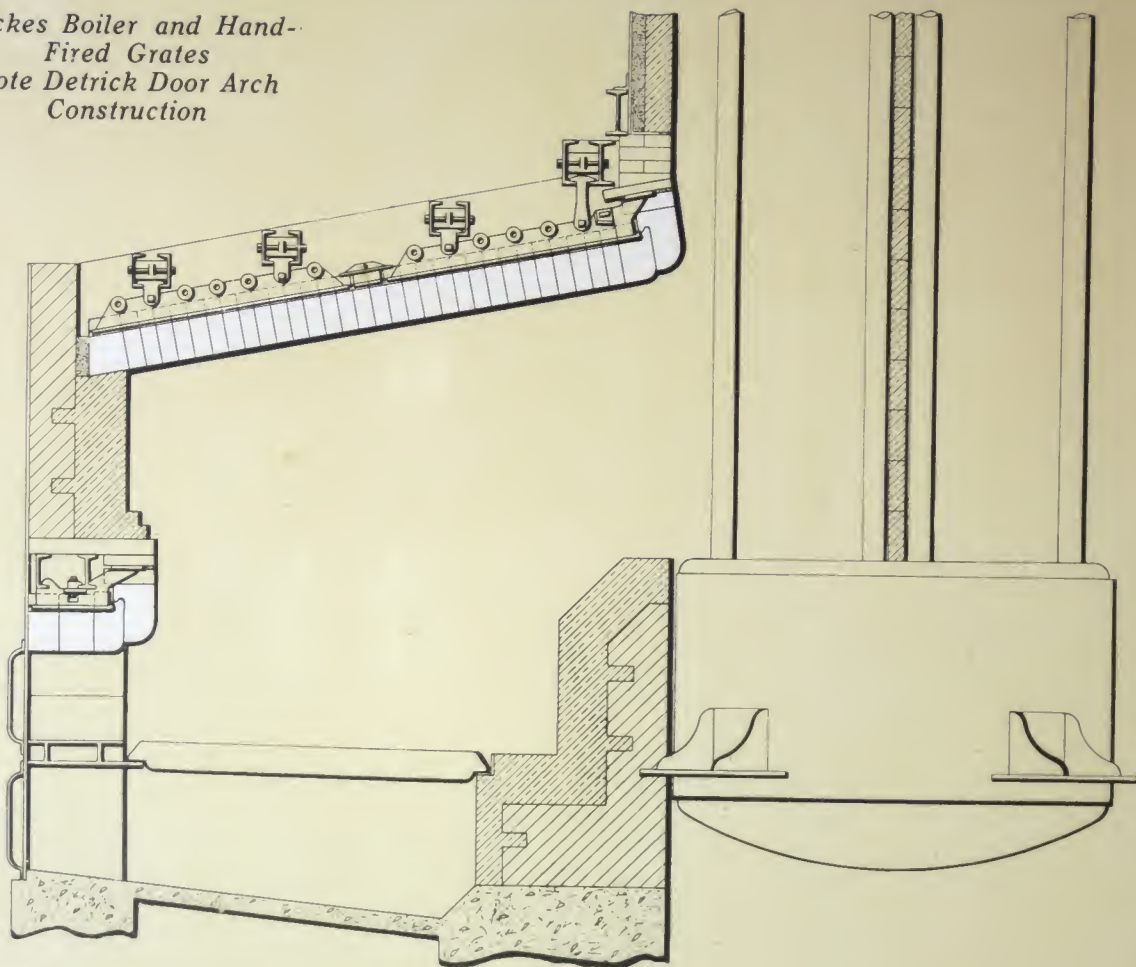
*Detrick Arch Between  
Top Drums and Front  
Wall of Bigelow-  
Hornsby Boiler*





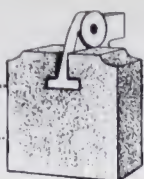


*Wickes Boiler and Hand-  
Fired Grates  
Note Detrick Door Arch  
Construction*

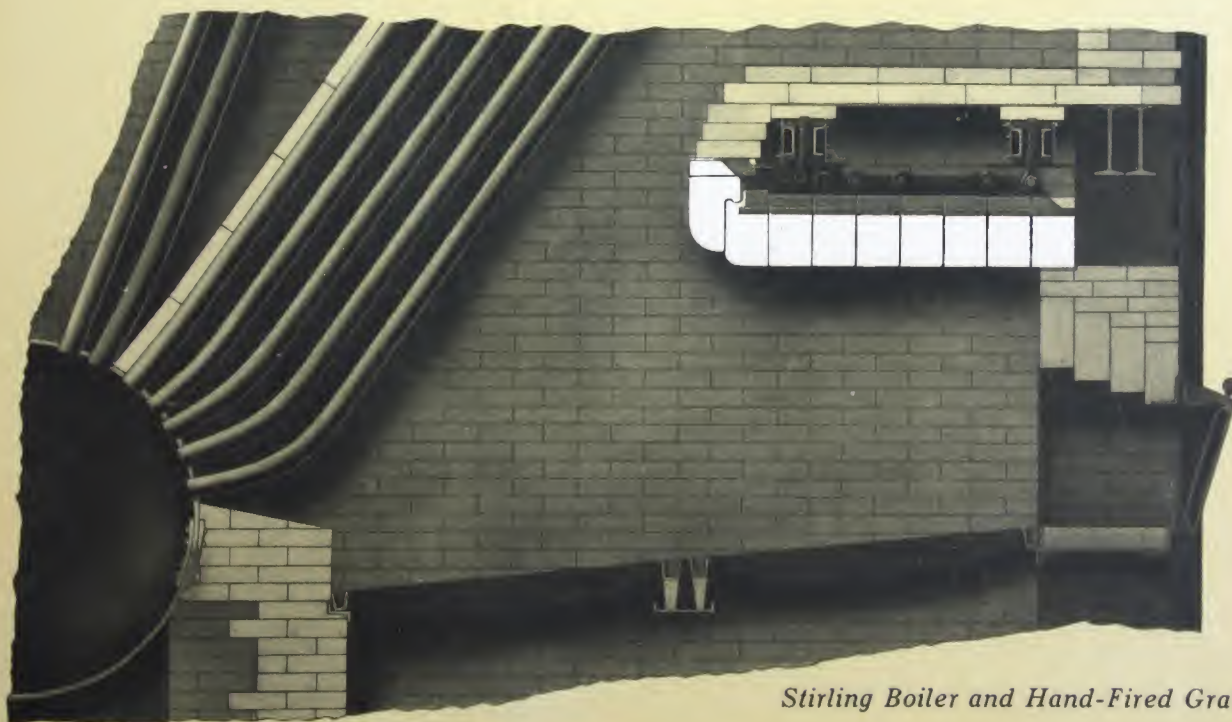
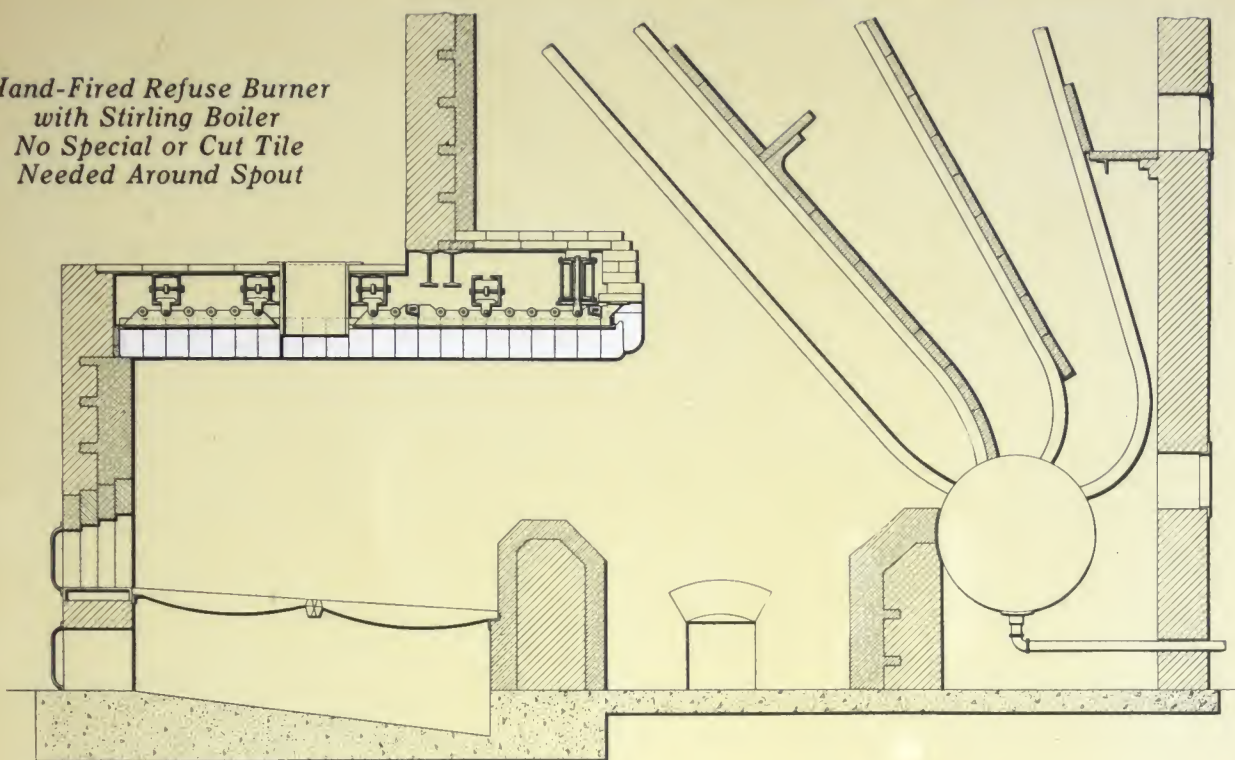


*Erie City Boiler and Bagasse Furnace with Double Arch*





*Hand-Fired Refuse Burner  
with Stirling Boiler  
No Special or Cut Tile  
Needed Around Spout*



*Stirling Boiler and Hand-Fired Grates*





## Detrick Arches with Oil-Burning and Powdered Fuel Installations

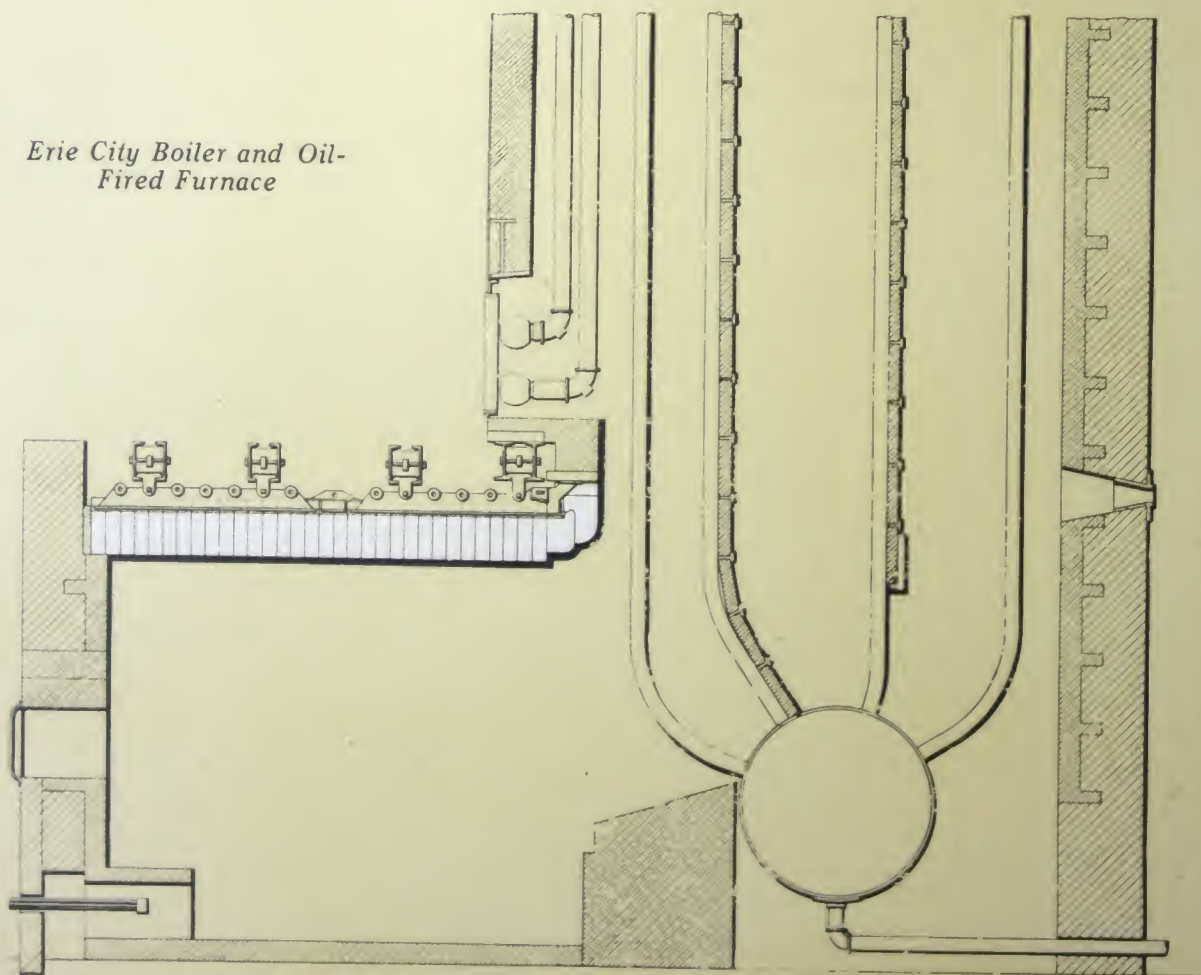
THE Detrick Arch has been used to considerable advantage where oil or powdered fuel is used.

High temperatures are obtained in both oil and powdered fuel installations. Practically all boilers equipped for burning powdered fuel are of such large size that only the flat arch is practical.

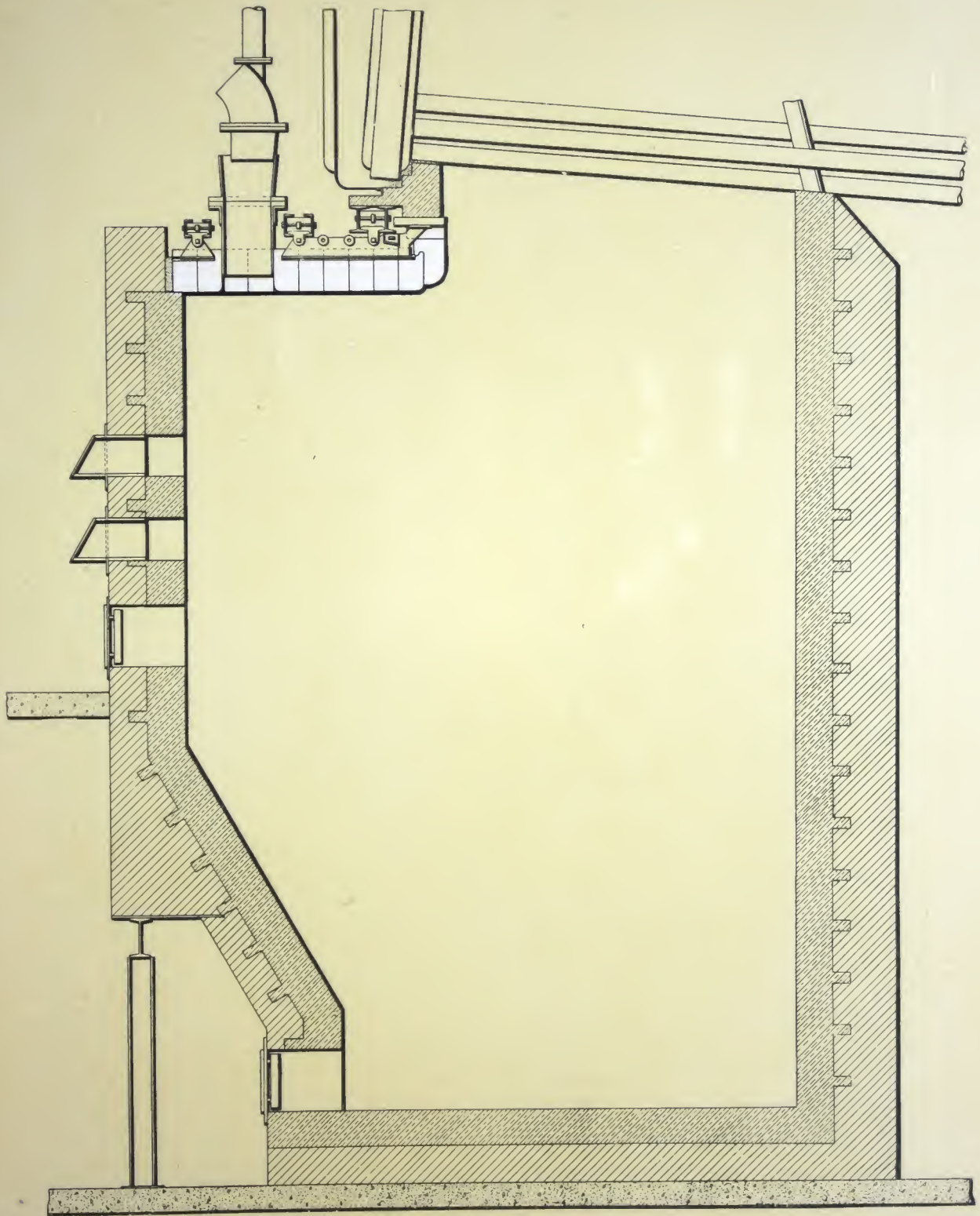
In powdered fuel installations, where the coal is fed through the top of the furnace, provision can be made for any number of feed spouts, in any location, without the use of special tile. No tile need be cut to fit.

Illustrations on this and the opposite page show the adaptability of Detrick Arches to these installations.

*Erie City Boiler and Oil-Fired Furnace*

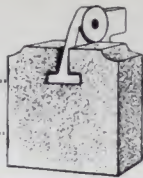






*Vertically Baffled Heine Boiler with Powdered Fuel Installation*





## Detrick Arches with Special Furnaces

IN the construction of heating furnaces, annealing ovens and special furnaces, Detrick Arches have been used with remarkable success. Where sprung arches are used considerable attention is given to the spacing of buck-stays and tie-rods. In spite of all these provisions the side walls after a short period of operation are buckled out of shape. At certain points it is impossible to repair the walls without tearing down the sprung arch.

Detrick Arches can be applied to such furnaces, with the structural beams resting on posts outside of the side walls so that the side walls will carry no strain whatever and will not have the tendency to buckle. Repairing of the side wall can be done with this type of construction without touching any portion of the arch. The arch can be repaired at any point without the necessity of tearing down any great portion of it.

The flat surface formed by this type of arch provides a more uniform and better distribution of the gases and flames. The gases do not have the tendency to collect near the center of the furnace, but can expand uniformly over the entire width. In this way the material in the furnace is heated more uniformly and efficiently.



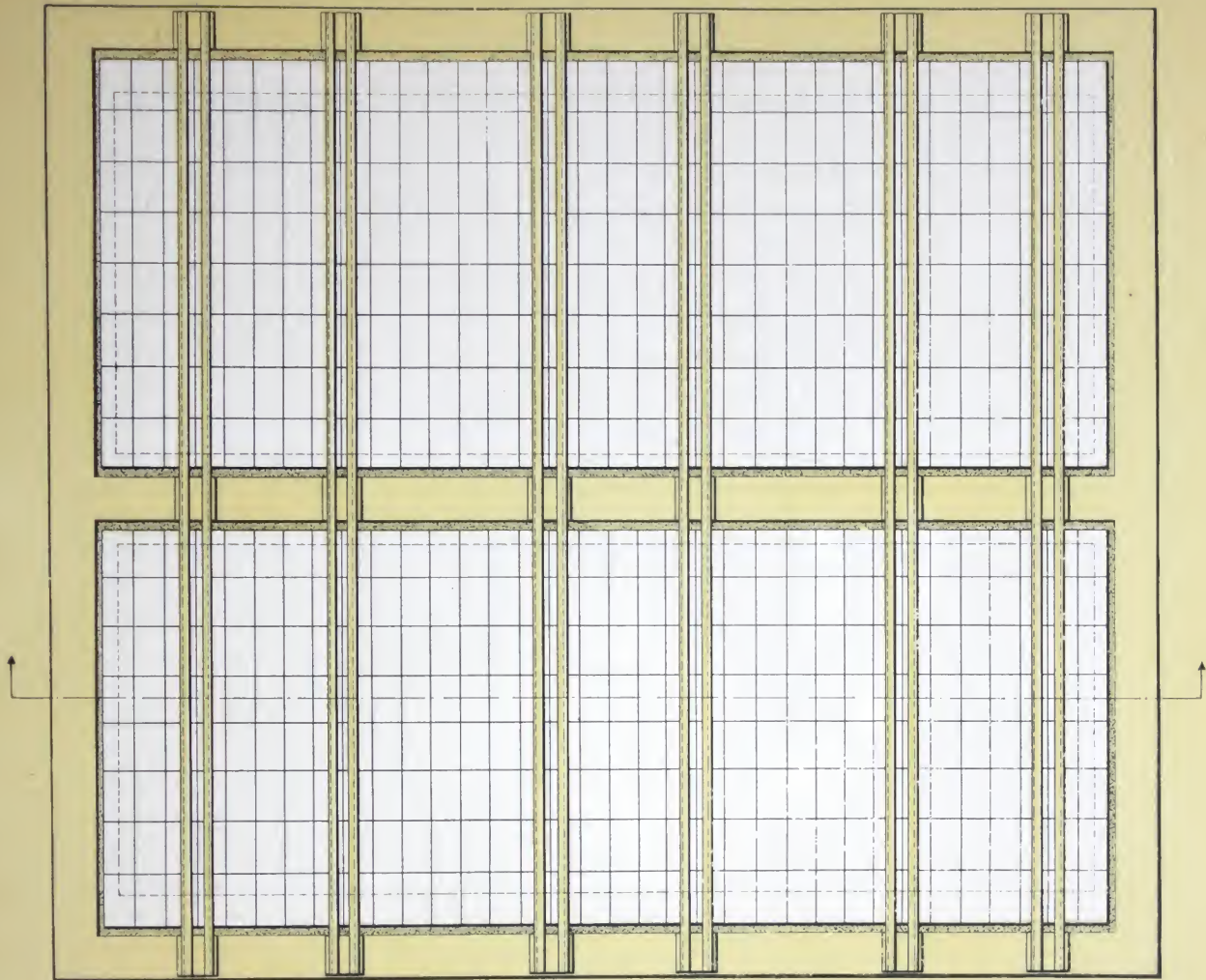
*A Detrick Arch in Use Over an Annealing Oven*





DETRICK

ARCHES

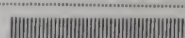


*Plan of Detrick Arch Installation Over an Annealing Oven*

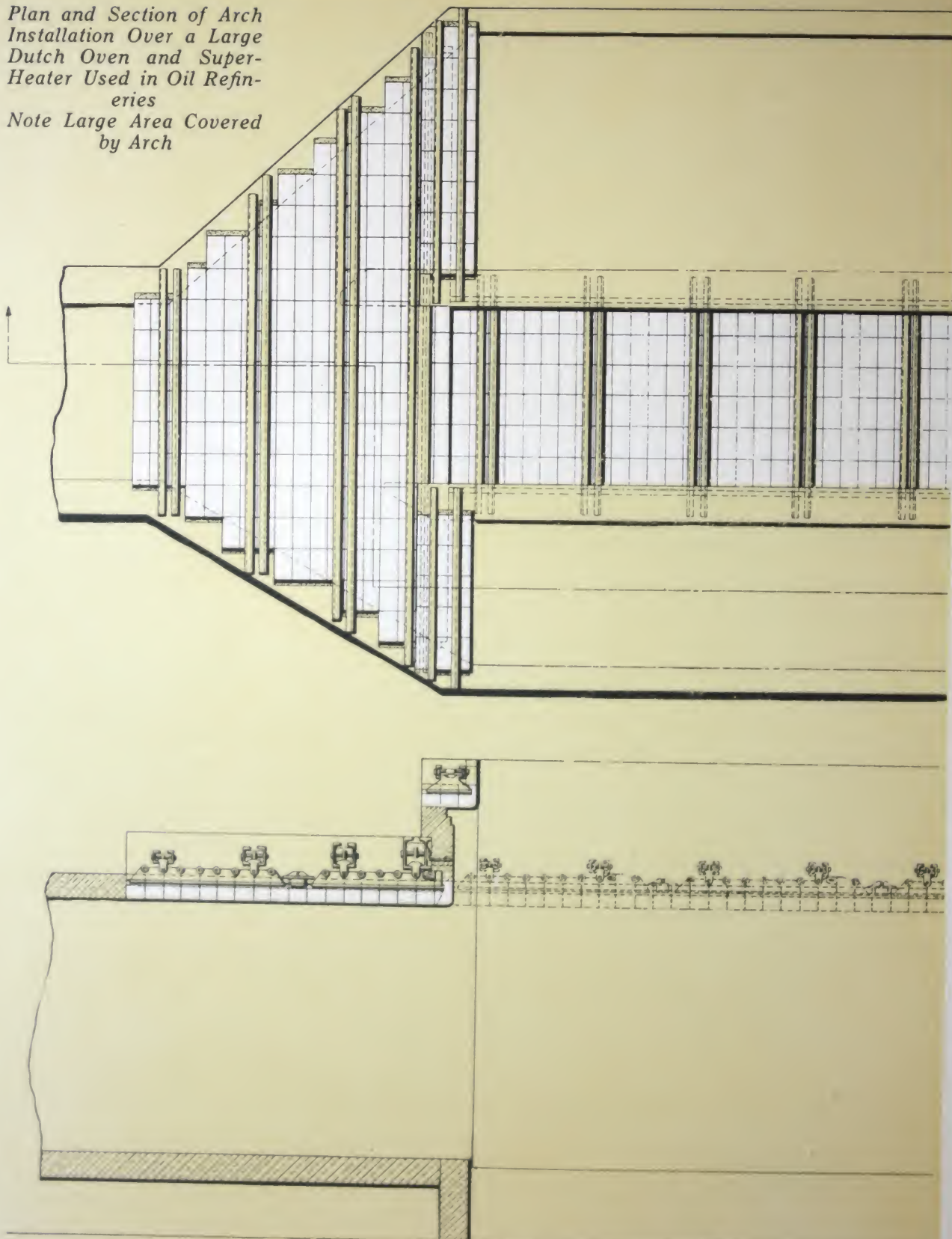


*Cross Section of Detrick Arch Installation Over an Annealing Oven*

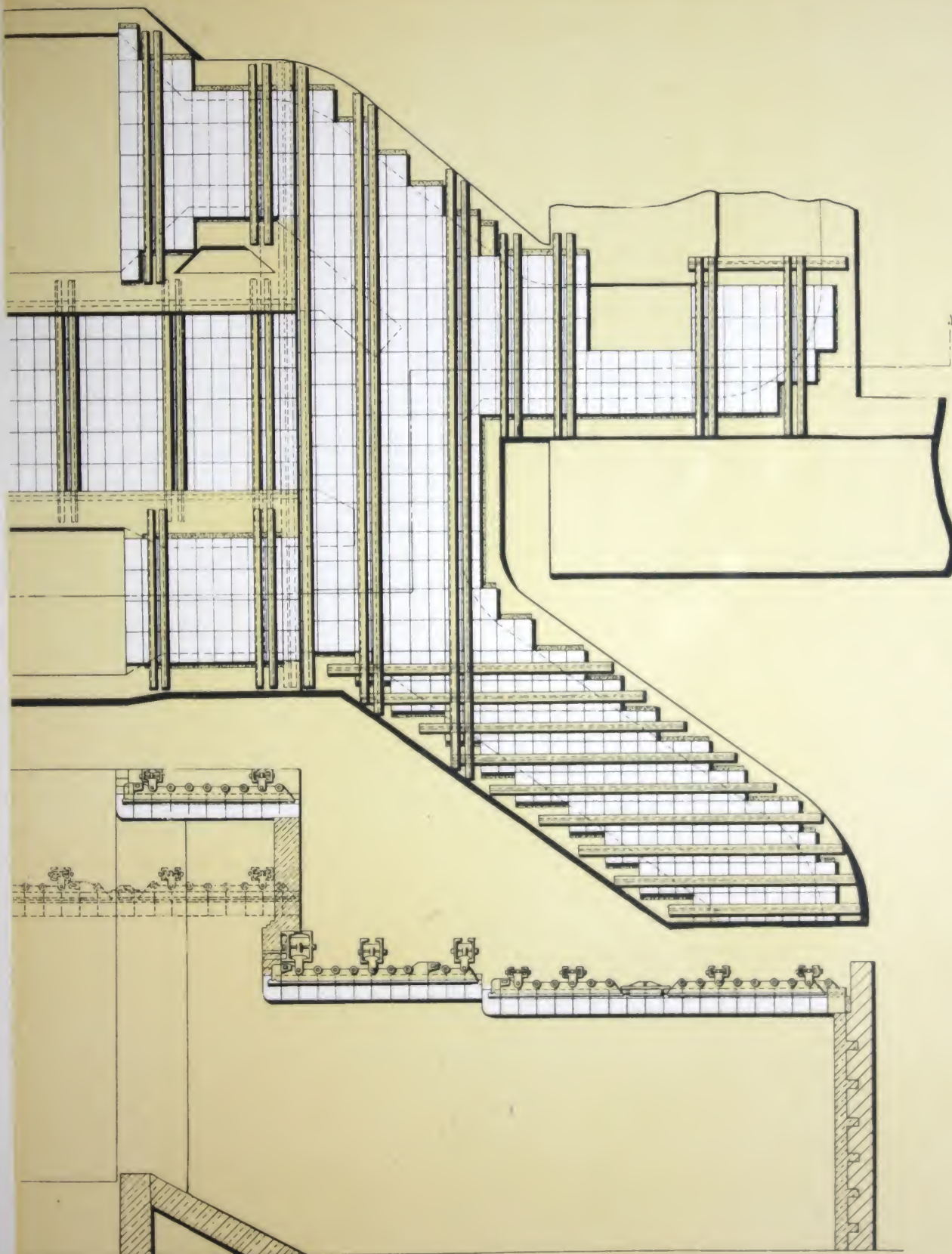




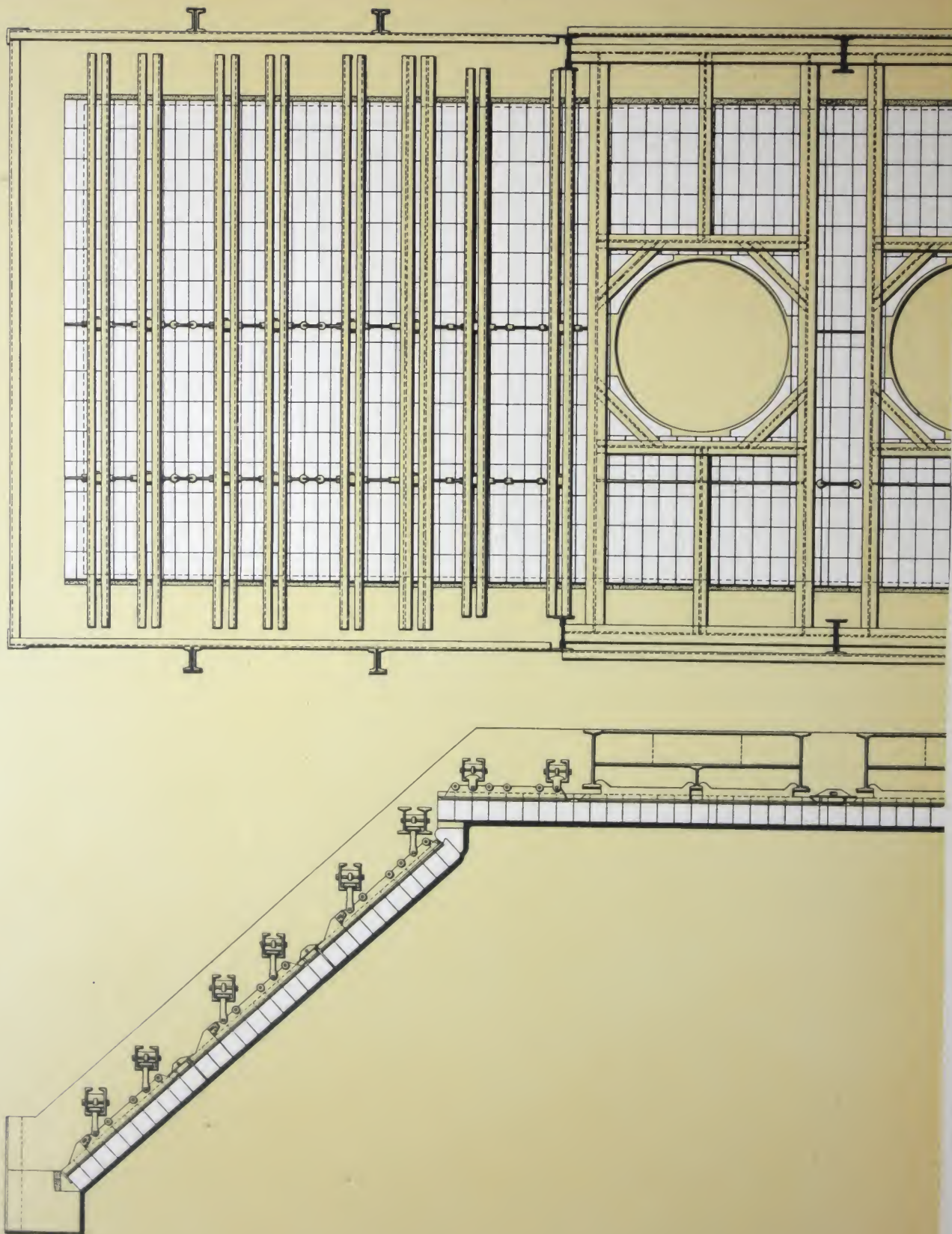
*Plan and Section of Arch  
Installation Over a Large  
Dutch Oven and Super-  
Heater Used in Oil Refin-  
eries  
Note Large Area Covered  
by Arch*



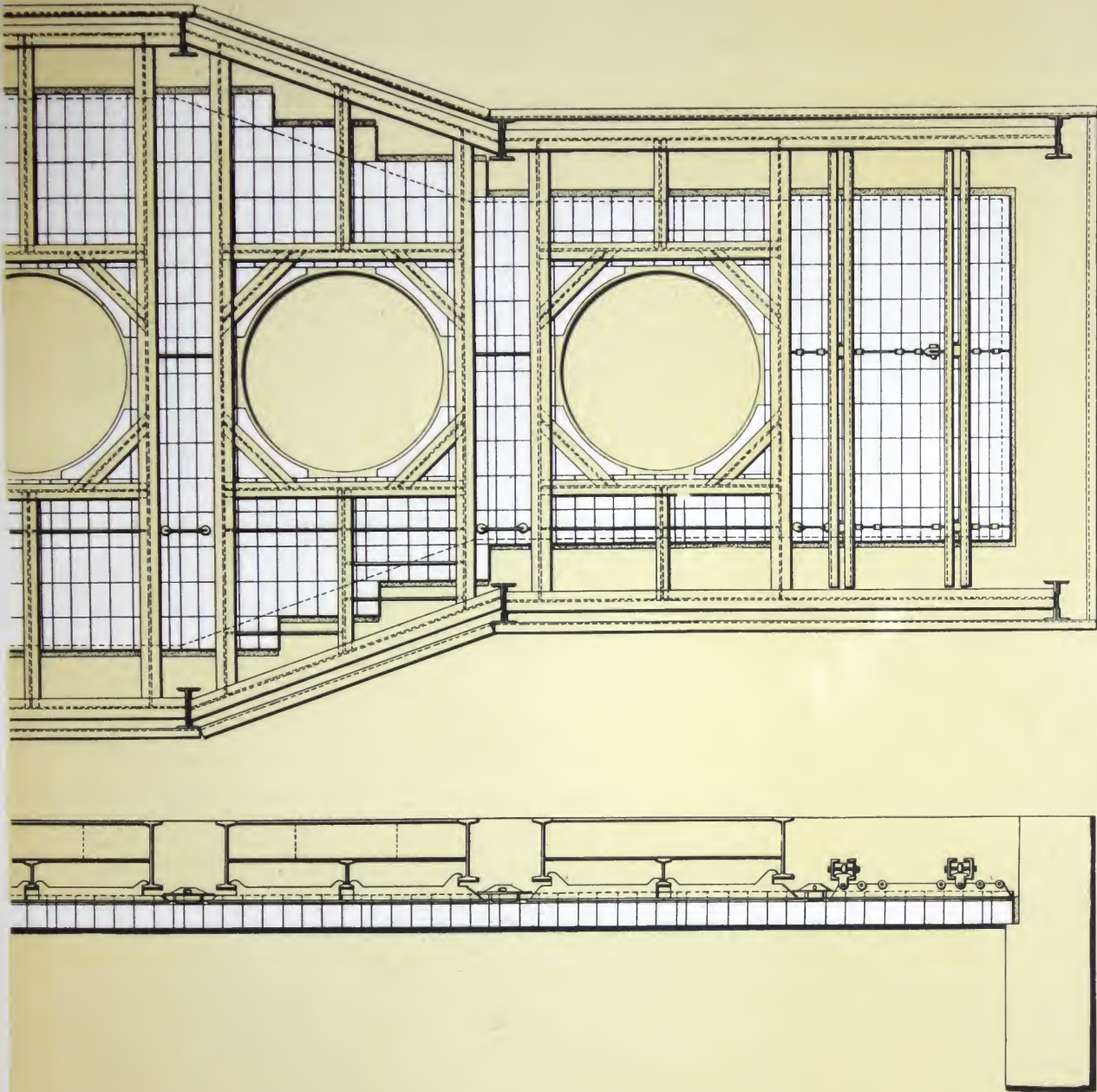






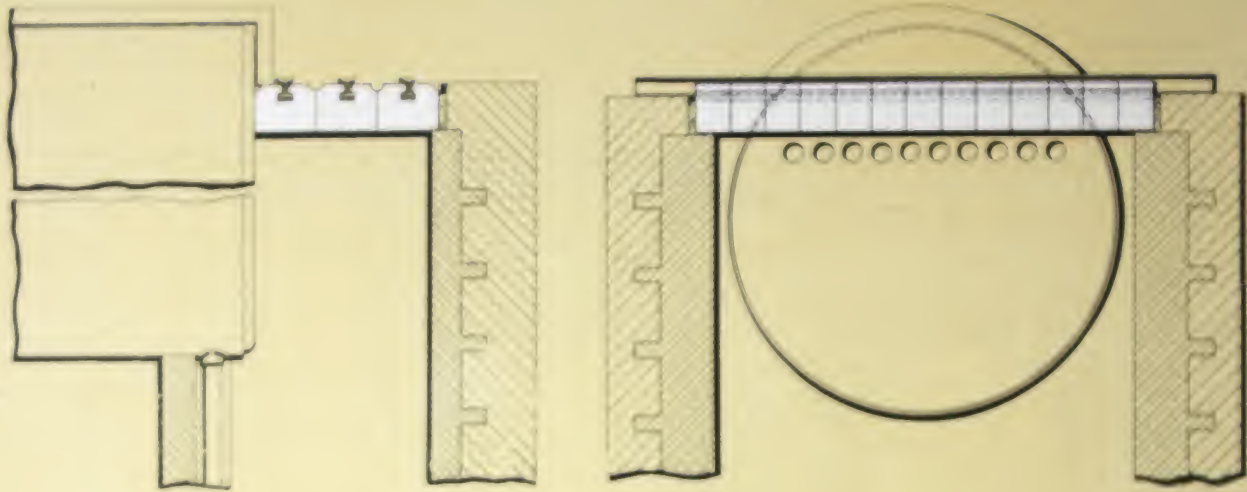
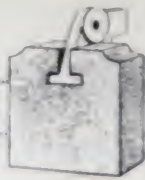




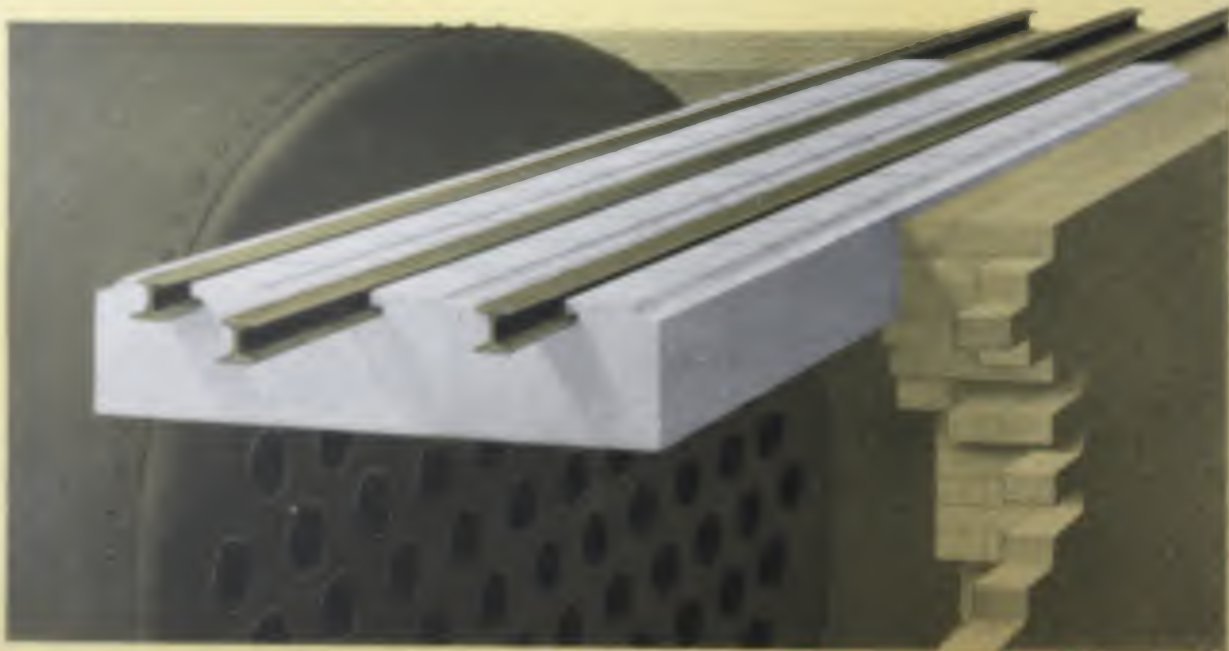


*A Detrick Arch Installation with an Oil Still Showing  
Adaptability of Arch to Special Designs*

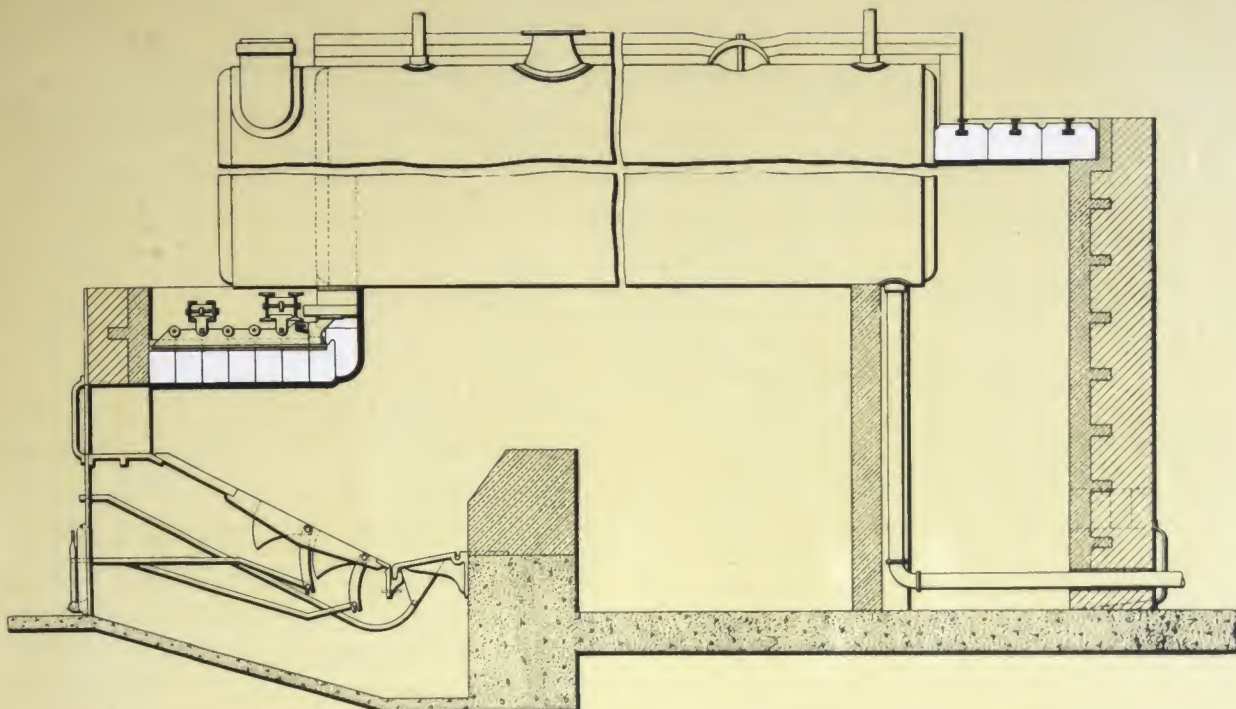
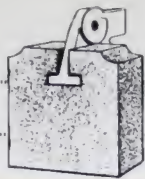




*Detrick Rear Combustion Arches, used at the rear of H. R. T. Boilers, consist of center-grooved tile suspended from I-beams. The I-beams rest on the side wall, so that all thrust on the rear wall of the boiler setting is eliminated. The rear wall will not buckle when the boiler expands. The arch is put in place with an expansion space to take up any expansion of the boiler and lasts indefinitely. The head room required for the installation of this arch is only 11 inches.*

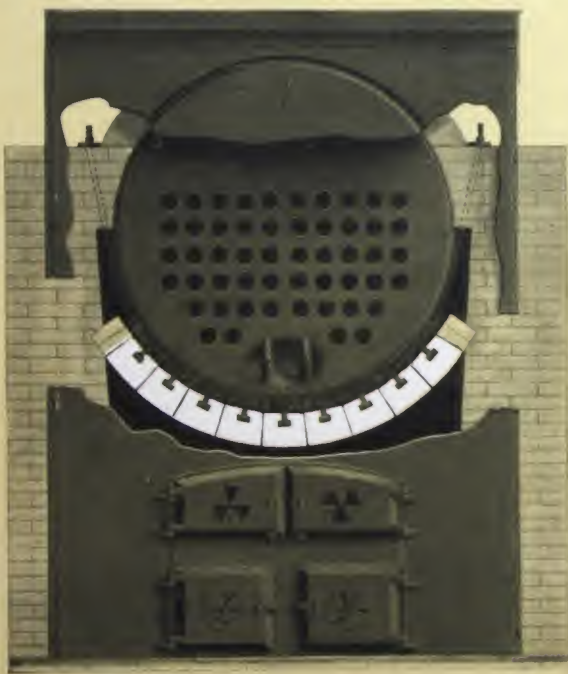






*H. R. T. Boiler and National Stoker. Note Detrick Rear Arch*

*Detrick Special Circular Arch Construction with H. R. T. Boiler*







## Ease of Installation of the Detrick Arch

THE illustrations on this and the opposite page picture the details of construction and the ease of installation of the Detrick Arch. The tile numbers referred to are shown in detail on page nine.



First, the beams are laid on top of the boiler walls. The entire arch is suspended from these beams and it will be noted that any pressure the weight of the arch might exert must be straight downward. This eliminates any necessity for buck-stays and skew-back irons demanded by the sprung arch.



Second, the erector is shown hanging the arch-bar casting from which the tile are suspended. The tightening of two bolts attaching this arch bar to the hangers that hang on the flanges of the supporting beams, is all that is necessary to attach this casting.



Third, each No. 1 or No. 13 tile is hung individually on the arch-bar—hung "like a pendulum," free to move forward or backward as the contraction or expansion of the arch demands.



Fourth, a removable end casting is attached to the arch-bar shown in the second picture. The slipping in place of one wedge secures it. On this the tile for the rear of the arch are hung, and it also furnishes a base on which to build the apron wall.



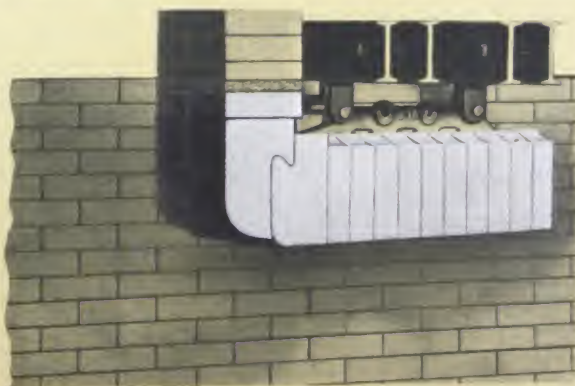
Fifth, hanging the No. 6 tile. Note that this tile also hangs loosely the same as the others.



Sixth, hanging the No. 7 or end tile. This completes the rear of the arch. Note that this tile hangs on the No. 6 tile previously described and is entirely supported by it, giving the same freedom for expansion and contraction as the other tile have. It is only half as wide as the No. 6 tile.



Seventh, arch completed, ready for the grouting. In these seven views are shown all the operations necessary to build one unit of a Detrick Arch.







## Engineering

*All important features of Detrick Arch design have been fully patented—but more important is the wealth of engineering experience gained in the building of arches for thousands of widely varying conditions.*

*Detrick engineers will gladly give assistance in the solution of any problem of arch application for boilers, heating furnaces, oil stills or special work.*







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